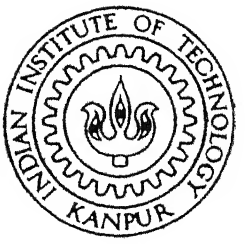
# MANUFACTURING STRATEGY : RELATING PROCESS TO CONTENTS

by

SHIVANSHU UPADHYAY






DEPARTMENT OF INDUSTRIAL & MANAGEMENT ENGINEERING

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# CERTIFICATE

This is to certify that the work contained in the thesis entitled " **MANUFACTURING STRATEGY : RELATING PROCESS TO CONTENTS** " by Mr Shivanshu Upadhyay has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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## ABSTRACT

In this paper a framework is proposed for the contents of manufacturing strategy for three different processes of manufacturing strategy formulation The contents of manufacturing strategy are the competitive priorities & the decision areas of manufacturing. The three different processes of manufacturing strategy formulation are, incremental, integrated & bold Four hypothesis are also embedded in this framework Market conditions often force a firm to change its focus from one set of objectives to another set A framework for various structural/infrastructural decisions for different set of objectives is developed Then an outline of the decisions to be taken to reorient manufacturing from one set of objectives to another set is given. An attempt is thus made in this work to develop a framework which will simplify the practical application of the principles of manufacturing strategy The theoretical framework was verified by using data from twenty manufacturing companies & doing subjective and correlational analysis

# ACKNOWLEDGMENT

I would like to express my sincere thanks to my thesis supervisor Dr. R R K Sharma Despite his demanding schedule, he made himself available whenever I required his guidance The many discussions that I had with him channelised my thinking and helped me in drawing meaningful conclusions. I am indebted to him for making this research endeavor fruitful

I am thankful to IME colleagues, for their invaluable support in carrying out this work I sincerely thank the other IME family members for their help and encouragement, provided to me during my Master's program

March, 1997 Shivanshu Upadhyay

# CONTENTS

# CHAPTER 1

## INTRODUCTION

The oldest branch of management is indeed production management However slowly with time in the early decades of this century manufacturing strategy became a neglected aspect of corporate strategy. Functional areas like marketing & finance captured the limelight relegating manufacturing strategy to the background However the declining competitiveness of the American industry vis-à-vis the Japanese in the 70's & the 80's forced management gurus to look for alternative avenues It was then left to scholars like Skinner, Hayes & Wheelwright who published a series of articles to bring manufacturing strategy into focus.

Although still a relatively new area of study & practice, most writers trace the beginning of manufacturing strategy as a field to Wickham Skinner's (1969) early conceptual work The conceptual work published in the 1970's encouraged many new authors to join the fray & the number of articles & outlets for manufacturing strategy writers have increased during the 1980's. An attempt is made in the next chapter to enlist some major areas of discussion.

One of the earliest areas of research has been the process of manufacturing strategy formulation & the contents of manufacturing strategy. Until very recently, this distinction has not been made explicitly in manufacturing strategy research The process-content distinction provides useful organising categories for manufacturing strategy research (Ward, Leong & Snyder (1990).In the present work we attempt to

venture into a very important but less researched field of linking process to contents Section 3.1 tries to identify in adequate detail the manufacturing focus in terms of low cost, high quality, high delivery, or high flexibility & manufacturing decisions in the form of important structural/infrastructural decisions for the three different processes of manufacturing strategy formulation. The processes are incremental, integrated & bold

Another important area of research is 'focus' and 'trade-offs'. Skinner argued that manufacturing has to be designed for a properly decided set of objectives It can not be expected to excel in all the fields But even he expected the fact that there has been little attempt to enlist, the areas of focus & how to design manufacturing once a company has decided to focus on a particular task For example manufacturing has to be designed in a particular way in the form of organisational structure, capacity planned, extent of vertical integration etc. when a company's manufacturing has to produce high quality goods which have a high delivery This manufacturing mission is derived from the corporate strategy of the organization The design of manufacturing in this case will be different from the case when the manufacturing has to produce say low cost goods irrespective of other criterion

In this work we try to simplify the wide and vague area of corporate focus in terms of easily comprehendable missions or objectives for manufacturing. A list of decisions to be taken to design manufacturing for objectives is then given. Finally we attempt to provide an outline of the key decisions to be taken to reorient manufacturing if a company wants to change it's manufacturing objectives as a part of it's restructured corporate strategy. In a highly competitive and dynamic market a company is always reassessing it's priorities. In wake of a changed scenario it is very

important to defocus & to make changes in the design of manufacturing according to the new focus

The theoretical framework developed is attempted to be verified to the maximum extent possible. Data collection was done from twenty companies for this purpose The plan of the thesis is, In chapter 2 we present a review of the relevant literature in these areas, In chapter 3, we present the developed conceptual framework, In chapter 4, the methodology adopted to verify the conceptual framework is given, In chapter 5, analysis of the data collected & discussion of results is given, In chapter 6, limitations of our study & scope for future work in this field is given. The questionnaire, the list of the companies & the data are given in the appendix

# CHAPTER 2

# LITERATURE REVIEW

Literature on manufacturing strategy revolves around certain particular areas. These include, importance of manufacturing as a strategic option, importance of integrating manufacturing operations with other functional areas, theories regarding process and contents of manufacturing strategy, paradigms relating manufacturing strategy to issues like technology acquisition and identification of stages in the manufacturing's strategic role Recent publications have questioned Skinner's manufacturing strategy paradigm New options like "lean manufacturing" and a host of "Advanced manufacturing technique's" (AMT's) have questioned the notions of "trade-offs" and "focus" ( Hayes & Pisano, 1996 ) , while others have argued that with everybody focusing on quality the issues of trade-offs are still valid ( Clark 1996 ) In this chapter an attempt is made to review some important aspects of manufacturing strategy.

## 2.1 Manufacturing in corporate strategy (MCS) -:

The earliest literature, which brought manufacturing strategy in vogue today is undoubtedly Skinner's pioneering work in 1969- "Manufacturing-Missing Link in Corporate Strategy". It introduced the concept of manufacturing in corporate strategy (MCS). MCS is essentially a theory of design: it says "design manufacturing systems for a purpose." Focus on a task that will create clear, strategic advantage. All system elements must be designed for that task and all must fit together for that purpose.

Implicit is the notion that design must come first, for with a poor or non-coherent design, no amount of patching or management effort can make the system work well Operating skills are vital of course, but alone they will not carry the day , which means that efficiency is not a substitute for effectiveness

According to Skinner (1996), perhaps an important reason for the survival of MCS is that it deals with the fundamental single most difficult dilemma inherent in the management of manufacturing A manufacturing system is by nature expensive and risky in capital, size, and location, it is complex in its systems, and requires trained workers and managers All these factors take considerable time to change Yet the system must produce output that is correct in quality, cost, time, and service to markets, all of which change amidst constantly changing economics, competition, technologies, and government policies The dilemma, then, is how to match something that is costly and risky and can be changed only very slowly with requirements that change continually and often quickly The MCS concept of system design and ongoing review of all manufacturing policies provides a framework and a set of procedures for dealing with this inescapable, relentless imperative of manufacturing

2 2 Competing through manufacturing -

A corporation formulates different functional strategies such as marketing, finance, personnel, organisation and manufacturing etc It is desired that all the functional strategies are a part of corporate strategy (Tilles, 1963) Any of these functional strategies may serve as a competitive edge for the corporation

The strategic view of manufacturing as a competitive weapon dates back at least to Miller and Rogers (1956) They did not differentiate between a business strategy and a manufacturing strategy Rather they saw manufacturing policies as necessary ingredients of business strategy The notion of manufacturing strategy as a separate but related functional component of a business unit strategy is of more recent vintage ( Skinner 1978, Hayes & wheelwright 1984 ) These works, highlighted the strategic nature of choices in manufacturing and the competitive power of an effective manufacturing strategy In every aspect of operations including production planning and inventory control, human resources, capacity planning, scheduling, facilities management, choice of process technology, and supplier relations-the choices involved should be seen in competitive terms and the requirements of the business strategy matched with the operating capabilities of the manufacturing system

The basic thrust of these authors have been to change fundamental misconceptions about the nature of manufacturing and, in particular, its role in the firm's competitive position What traditionally had been considered routine , low-level decisions often had important unrecognised and unexploited strategic consequences

The concept of manufacturing strategy envisions a very different kind of manufacturing organisation, where decisions in manufacturing play a critical, strategic role in the business There may be routine and pressure in the manufacturing operation, but those operations provide capabilities critical to the business's competitive success This perspective on manufacturing and the framework that flows from it are based on six central propositions (articulated in somewhat different form in Hayes and Wheelwright 1984, and Skinner 1974) -

(1) There are many ways to compete

(2) Firms cannot be all things to all people

(3) There are many trade-offs in manufacturing decisions about structure and infrastructure

(4) Manufacturing strategy is defined by the pattern of decisions across many categories of structure and infrastructure

(5) A manufacturing strategy's success is determined by the coherence of the pattern across decision categories, and by the match between the strategy, other functions, and the overall business

(6) Over the longer term, a manufacturing strategy succeeds as it guides the business in building capabilities essential to achieve the firm's chosen competitive advantage

Taken together, these propositions establish the necessity of choice in manufacturing, characterise the nature of the choices the firm confronts, and define criteria by which one may judge the quality of emerging strategy

2.3 Definition of Manufacturing Strategy -

As a summary of the above discussed aspects, a broad definition of manufacturing strategy can be given The following definition is offered

> Manufacturing strategy provides a vision for the manufacturing organisation based on business strategy It consists of objectives strategies and programs which help the business gain, or maintain, a competitive advantage

Two things in this definition should be highlighted A manufacturing strategy is more than just a plan It should provide a vision for where the organisation is headed Second, the manufacturing strategy should contain long-range objectives, as well as, strategies and programs for manufacturing

The manufacturing strategy must, of course, be linked closely with the business strategy and other functional strategies This is accomplished by explaining the business strategy as the first part of the manufacturing strategy planning process and by involving various functional people from outside manufacturing in the process

2 4 Literature review on Contents of Manufacturing Strategy -

Manufacturing function is technical in nature, and hence researchers have identified the "contents" which top management could consider while making strategic decisions Significant work has been done to guide the top management to choose an appropriate set of priorities while planning the manufacturing function The "content" of the manufacturing strategy are broadly classified into two categories

(1) Decision areas of long term importance in the manufacturing function

(2) Competitive priorities that help in appropriately targeting the manufacturing resources (Ettlie and Penner-Hahn, 1990)

Earlier the top management of corporations (Skinner, 1969) ignored the manufacturing function and delegated its responsibility to the manufacturing vice presidents who had dominant technical competence and little or no general management abilities They tended to emphasise a single criteria for which they geared

their manufacturing facilities and failed to correctly prioritise the different criteria in light of market conditions

Skinner (1969) was first to point out such a state of affairs in the United States and stressed the need for developing a framework shorn of technical nut bolts that would help the top management of manufacturing organisations in appropriately designing the manufacturing strategies Later work by Skinner (1978) led to the identification of following performance criteria for the manufacturing facilities- manufacturing cost per unit of output, delivery time, quality and investment in manufacturing facilities

It was argued that to be successful a specific market segment would require a specific ordering of the priorities around which the respective manufacturing facilities would be built Logical extension of this led Skinner (1978) to come up with the plant within a plant concept (PWP for short) which essentially sought to segment the production facilities to cater to each of the market segment, so that each segment has its own set of priorities to give superior performance for a specified market segment Each segment of productive facilities is then able to develop a unique culture that is suitable to give high performance while serving a specific market segment It was realised that it was not possible for a particular manufacturing facility to be able to meet different performance standards Skinner (1969) had earlier given a very useful efficiency/effectiveness interpretation of this phenomenon

Other notable contributions to the manufacturing strategy literature are the plant and equipment strategy and personnel strategies Skinner (1974) has suggested five decision areas where management makes trade-off decisions (1) Plant and equipment (2) Production, planning and control (3) Labour and staffing (4) Product

engineering and design (5) Organisation and management Fine and Hax (1985), Hayes et al (1988), Hayes and Wheelwright (1984) and Buffa (1984) have added other decision areas such as (6) Structural (capital spending) and infrastructural (manufacturing system and people) decisions (7) Vertical integration (direction, extent, balance, number) (8) Technology (9) Capacity (Amount, utilization, timing) (10) Ability to introduce new products (11) Trying to evolve a fit between product process and life cycles Wheelwright and Bowen (1996) have listed some more decision areas These are - (12) Information technology (maintainence, material flows, production planning, cost tracking) (13) Customer (access, relationship, support) (14) Quality management (definition, role, responsibility, yields) (15) New products (integration, start-up, modification) (16) Process technologies (scale, flexibility, interconnectedness) (17) Facilities (type, size, location, specialization) If we combine the competitive priorities of Skinner (1969,1978, 1985), Wheelwright (1978, 1981, 1984), Buffa (1984), Hayes and Wheelwright (1984), Fine and Hax (1985), Hayes (1985), Van Dierdonck and Miller (1980), and Hayes et al (1988), then we obtain the following six dimensions (1) Manufacturing cost (2) Delivery performance, dependability and speed (3) Quality (4) Flexibility - product mix and volume (5) Innovativeness (6) Investment in productive facilities

## 2 5 Literature review on Manufacturing Strategy making Process -

Now we turn our attention to the "process" of manufacturing strategy making Ettlie and Penner-Hahn (1990) have noted that literature on manufacturing strategy making process is not well developed Little work is available which is

summarised below By using a broad planning process which involves other functions in the company, manufacturing can significantly improve its communications with other functions Such a planning process will help others understand where manufacturing is headed and why certain objectives and strategies are being pursued

Skinner's (1984) work suggested a hierarchical model in which corporate strategy drives the manufacturing strategy and other functional strategies But Hayes (1985) has argued that functional capabilities drive the corporate strategy in some cases Miller and Hayslip (1989) have suggested that capability development and strategy planning activities should be under taken jointly to achieve competitive advantage Hill (1985, 1989) has put emphasis on the importance of order winning marketing function in his process model of manufacturing strategy Chase and Garvin (1989) have depicted measures to emphasise the "fit" of capabilities brought to bear by each function Swamidass and Newell (1987) have noted in their seminal work that if top management follows "interactive" process of strategy making, that is when manufacturing managers participate in corporate strategy making, then it yields significantly better results, but they do not give the "contents" of these interactions

It may be argued that when manufacturing managers do not participate in the corporate strategy making, it may result in different processes being used for corporate and manufacturing strategy making Skinner (1968) has already pointed out the gap existing between corporate and manufacturing executives

Hayes and Wheelwright (1984) have suggested that firms investment in manufacturing facilities could lead or lag or be on time with the emergence of demand, but they have not discussed the processes used for formulating the

manufacturing strategies Ettlie (1990) has noted that basic understanding of the manufacturing strategy process has not been reached, nor the subject has received adequate debate or field research

Sharma and Ghosh (1996) have tried to extend the process models of corporate strategy making to the manufacturing strategy making process The present thesis work tries to formulate manufacturing strategy (contents) for the different processes of manufacturing strategy making as attempted by Sharma and Ghosh (1996) To understand, how processes of manufacturing strategy making were derived from process models of corporate strategy making, a brief review of the processes of corporate strategy making is given in the sub-section below

2 6 Literature review on corporate strategy making process -

Miller (1987) has presented a summary of different corporate strategy making process used and documented by researchers The literature has identified three multifaceted dimensions of strategy making process rationality, interaction and assertiveness

The first dimension, rationality, suggests careful analysis of problems and opportunities, scanning of markets, methodical planning, stress on long term objectives, use of analytical tools in strategy formulation and articulating unified strategies (Ansoff 1965, Steiner 1969) It has been referred to as synoptic by Frederickson (1984), planning by Mintzberg (1973) or rational by Miller and Frieson (1984)

The second dimension of the strategy formulation process is "interaction" The name is derived from the fact that men with limited cognitive abilities make decisions while interacting with each other through the process of argumentation (Lindblom and Braybrook (1959)) Men have limited cognitive abilities and organisation structure places bound on the rationality (March and Simon 1958, Simon 1947) and when faced with complex problems, they only satisfice by doing little analysis and formulate strategies according to disjointed, intuitive, implicit and spontaneous process (Cyert and March (1963), Lindblom (1959), March and Olsen (1976), Quinn (1980)) It has been claimed by these authors that such a non-rational approach is necessary due to wide range of complex problems faced by the organisations, and the attendant cognitive limitations and the social and political contexts in which decisions have to be made Hence politically fragmented firms operate in an adaptive mode (Mintzberg 1973) where goals and means are discovered through a process of argumentation This process invariably leads to changes in incremental steps

The third dimension of strategy making process is assertiveness which is concerned with the riskyness of strategy and reactiveness and proactiveness of decisions Entrepreneurial firms act ahead of their environments by taking bold decisions (Miller & Frieson (1984) and Mintzberg (1973) ), where as more complex firms often act conservatively by acting only reactively to the environmental changes (Cyert and March (1963) and Quinn (1980))

Strategy making process is applicable in general and hence it was proposed (Sharma 1996) that it will be applicable to the area of manufacturing as well

Hence manufacturing strategy making process can also be categorised into three dimensions, i e , rational, interactive and assertiveness

It was hypothesised that rational manufacturing strategy making process would mean to extensively analyse of all possible variables and options before arriving at decisions A rational process of manufacturing strategy would analyse the benefits of extensive vertical integration and economies of scale in terms of cost leadership, or would suggest extensive joint ventures with vendors to keep investments in manufacturing facilities at a minimum level to have a high return on investment Conventional ideas of rationality seemed to suggest centralisation of manufacturing facilities in the CIMS paradigm

Interactive mode of manufacturing strategy making process would mean that firms manufacturing managers stress consensus before making decisions Such an approach would lead to policies that seek incremental departures from the past and would lead to incremental additions to manufacturing facilities

An assertive manufacturing strategy would mean to a bold steps with respect to manufacturing resources with investments in manufacturing facilities ahead of competitors

It has been argued that when costs are falling due to various economies of scale bold approach is preferred as happened, before 1980's in the U S and is followed by an interactive/incremental approach to manufacturing strategy making process as happened in 1980's in U S ( Leone and Meyer , 1980 )

It was proposed earlier by Skinner (1968) that technical nature of manufacturing creates gap between strategically oriented corporate executives and technically oriented manufacturing executives Hence in an organisation it is

possible that different processes are being used for corporate and manufacturing strategy making Different processes of corporate and manufacturing strategy making could lead to varied effectiveness Apart from differences in processes of corporate and manufacturing strategy making the type of environment surrounding the firm also influences the degree of effectiveness achieved by them Swamidass and Newel (1987) also hold a similar view Hence a brief review of typology of environment is given in subsection below

2 7 Typology of environment -

Many authors have attempted to describe or dimensionalize organisational environments One of the earliest and most influential attempts was the work of Emery and Trist (1965) Emery and Trist (1965) described four types of environment, which differed according to the source and nature of the interdependence between organisation and environment The first type is called placid-randomised, referred to a situation in which resources desired by the organisation are randomly distributed throughout the environment The second type of environment is called placid-clustered, referred to an environment in which pattern of resources can be predicted sequentially The third type of environment called, disturbed reactive, refers to an environment which is affected by the actions of the organisation itself and in economics terms the environment is referred to as oligopolistic The fourth type of environment called, turbulent, refers to an environment in which invisible actions in the interconnected subsystem of environment have profound effect on organisation's immediate exchanges

Task environments have been characterised by March and Simon 1958) as hostile or benign Dill (1958) distinguished task environments as homogeneous or heterogeneous, stable or rapidly shifting and unified or segmented Duncan (1972) has identified two dimensions of environment The simple-complex dimension is defined as the number of factors taken into consideration in decision making The static-dynamic dimension is viewed as the degree to which these factors in the decision unit's environment remain basically the same over time or are in a continuous process of change He has found that the static-dynamic dimension of the environment is a more important contributor to uncertainty than the simple-complex dimension

The processes used for corporate and manufacturing strategy making, together with the environment being faced affects the overall performance of the firm

2 8 Theoretical framework of Manufacturing Strategy making Processes -

Here we give a broader discussion on manufacturing strategy making process hypothesised in the earlier sections

A firm pursuing a 'rational' approach to strategy making would use analytical tools such as linear programming and simulation for major marketing and financial decisions, use periodic brain storming, have formalised systematic search procedures for opportunities and use specialists for preparing reports and have a futuristic orientation Such an approach to strategy making would lead to an integrated strategy where firm would benefit from synergy between various decisions,

see Ansoff (1968) Carefully planned vertical integration and attention to technology would be corner stone of an integrated strategy driven towards cost leadership A firm with a rational approach to manufacturing strategy could aim to limit its investments in manufacturing resources (with a view to maximise its return on investment) by entering into joint ventures with vendors A firm pursuing an integrated manufacturing strategy through the rational process of strategy making would extensively use the computer integrated manufacturing systems (CIMS) and lead to centralisation of manufacturing facilities A firm analysing all possible variables and choosing a "rational" process of corporate strategy making and choosing a "rational" process of manufacturing strategy making is likely to have an integrated corporate and manufacturing strategies and hence have good performance in both stable and turbulent environments

A firm may choose an "interactive" approach to corporate strategy making either because it faces an uncertain environment or because it faces resource constraints, or because it faces complex internal environment A firm pursuing an "interactive" approach to corporate strategy making process is likely to take small steps each time and hence most likely to pursue an "incremental" approach to manufacturing strategy making by investing in little to moderate quantities each time and/or making few departures in personal policies relating to manufacturing divisions A firm choosing an "interactive" and an "incremental" manufacturing strategy will most likely invest in production facilities which require moderate investment The firm would then attempt to sell a differentiated product which can command a relatively higher price which makes up for a relatively higher cost of production A firm possessing a large production set-up aimed for the

low per unit cost of manufacture, can produce alternate products by appropriately stressing tool engineering, and thus be able to take a comprehensive approach to strategy making But a firm with moderate investment in production facilities may face problems when it is required to compete with a firm that has integrated strategy and hence is a cost leader Hence, a firm pursuing an interactive approach to manufacturing strategy making either due to resource crunch, or uncertain environment, or high internal complexity, may be required to pursue an "incremental" approach to making corporate strategy (Hays 1985), and therefore a firm with incremental manufacturing/corporate strategy may result in poor performance When environment becomes uncertain, firms prefer incremental approach to strategy making and take lesser risks and make incremental investments in manufacturing Also a firm pursuing an "incremental" approach to manufacturing strategy making will be able to realise only an "incremental" corporate strategy and vice-versa Incremental approach to corporate and manufacturing strategy making may be desirable in uncertain environments, but incremental approaches to corporate and manufacturing strategy making in stable environments may lead to poor exploitation of opportunities

Bold steps means, making moves ahead of competitors by making early investments in manufacturing and marketing Firms in stable environments or firms with entrepreneurial leaderships take a bold approach to corporate and manufacturing strategy making and make larger investments in manufacturing ahead of their competitors to obtain superior performance

In uncertain environments if a firm chooses to take a bold approach to corporate strategy making with a view to pre-empt or overtake competition, then it is taking a

relatively larger risk Firms can choose to reduce risk by appropriately emphasising the order winning marketing function as suggested by Hill (1985,1989)

2 9 Stages in Manufacturing's Strategic Role -

Hayes and Wheelwright (1984) identified four stages in the development of manufacturing's strategic role Stage 1 or "internally neutral" companies focus on minimising the negative potential of manufacturing, primarily through the use of planning and control systems Stage 2 or "externally neutral" companies seek to achieve manufacturing parity with competitors and regard capital investment as the primary means for doing so Stage 3 or "internally supportive" companies relate manufacturing decisions to the business strategy and systematically address longer-term manufacturing trends and new process technologies Their view of manufacturing strategy is similar to the hierarchical view At the highest stage, Stage 4, manufacturing is "externally supportive" of the company's objectives Stage 4 firms actively involve manufacturing in marketing and engineering decisions, seek to anticipate new technological developments, and pursue long-range programs to acquire manufacturing capabilities before they are needed

Many manufacturing firms remain at Stage 1 or at stage 2 unless they are forced by competitive pressures to move to Stage 3 or Stage 4 The transition from Stage 3 to Stage 4 is difficult Hayes and Wheelwright state that Stage 4 companies are generally recognised by three characteristics continual in-house process innovation, in-house development of manufacturing equipment, and close attention to both the structural and infrastructural aspects of manufacturing management These

characteristics are frequently seen in the excellent manufacturing operations of German and Japanese firms

2 10 New Developments -

1) AMT's and Manufacturing Strategy-

After about ten years of floundering in the 1970s, revitalised management efforts concentrated upon the diligent applications of such exciting management tools as total quality management (TQM), just-in-time (JIT), lean and agile manufacturing, and computer integrated manufacturing (CIM) and about twenty other well known and increasingly popular advanced manufacturing techniques

These AMTs have certainly improved results enough to keep many companies from continuing to slip competitively But there is an obvious problem with this mode of improvement because these AMTs are available to all competitors, they cannot and do not create robust competitive advantages They may improve results and reduce competitive disadvantages and thereby keep the renewed firm from going under, but this is not an approach to becoming an industry leader

Further these currently popular techniques are generally sound where properly understood and applied For example, JIT and MRP2 are marvellous creations, but they are very different and need to be chosen for relevancy to the process and other elements of a coherent infrastructure It is seldom realised that many techniques are in conflict with each other

2) Capabilities based approach to Manufacturing Strategy -

Throughout the 1980s people grappled with the paradox of manufacturing strategy in different ways On the corporate strategy side Prahalad and Hamel (1990) contended that firms should focus on building "core competencies" that could create competitive advantages in a variety of market From the manufacturing strategy side Hayes (1985) arrived at a similar conclusion He observed that many of the most successful companies tend to focus more on building basic internal capabilities than on achieving specific market or financial goals Such capabilities, developed through a long sequence of incremental advances, could either be very general (such as extremely precise process control, which permitted very low defect rates and/or product miniaturisation ), or quite specific, such as developing experience in certain technologies or markets Then, as new business opportunities were created by changes in markets, technologies and the competitive environment, these companies would exploit those that were particularly susceptible to the specific capabilities they have created These new initiatives, in turn, would provide the impetus to create new capabilities This is, in essence, the capabilities- based approach to strategic planning

3) Dynamic trade-offs -

A company that adopts a capabilities-based approach to operations strategy has to commit itself to continual improvement because capabilities are ephemeral Even if a firm makes the appropriate trade-offs between, say cost and delivery performance , it will not prevail against competitors that are able to achieve higher performance along both dimensions This suggests that manufacturing strategy framework must expand to incorporate the notions of paths of learning, or "improvement trajectories" (Clark 1996) Rather than focusing primarily on static (first order) trade-offs, the emphasis of

much of the early writing about manufacturing strategy, the concept of improvement trajectories provide a vehicle for thinking about dynamic, second order trade-offs Hayes and Pisano (1996) argue that, it is possible for the companies to improve along more than one dimension (e g , cost and flexibility) at the same time, but not all performance dimensions can be improved at the same rate The amount of "focus" depends in large part on the company's improvement trajectory and where it is on that trajectory

# CHAPTER -3

# CONCEPTUAL FRAMEWORK

## 3.1 RELATING PROCESSES TO CONTENTS

The manufacturing strategy of a firm is derived from it's corporate strategy The three pure processes of corporate strategy formulation are Interaction, Rationality and Assertiveness These give rise to three processes of manufacturing strategy formulation Incremental, Integrated, Bold The contents of manufacturing strategy are the manufacturing objectives which follow from the manufacturing mission and the major infrastructural, structural decisions which are taken to achieve the decided objectives

The present work derives manufacturing objectives that follows from the selection of a manufacturing strategy formulation process Decisions regarding some major manufacturing parameters to achieve these objectives are then taken The manufacturing objectives and parameters together form the contents of manufacturing strategy formulation Thus a link is formed between the manufacturing strategy making process and its contents

The three types of manufacturing strategy making processes described in brief are

(1) **Incremental** A firm facing severe resource crunch and for complex uncertain environment would pursue 'incremental' approach of manufacturing strategy Such a firm prefers moderate investments in facilities and takes lesser risks It would seek to reach consensus between its various manufacturing executives before taking a decision

(2) **Integrated** A firm using integrated process of strategy making would use analytical tools such as linear programming and simulation for major decisions It would hence formulate unified and synergistic strategies Such a firm will extensively use CIMS, JIT, TQM and AMT's like FMS

(3) **Bold** A firm pursuing bold approach will make bold investments in manufacturing and marketing ahead of it's competitors Such a firm also makes high investments in design and research

The objectives which need to be balanced by a manufacturing firm are

(1) **Cost**

(2) **Flexibility** ( Both new product introduction and changing the scale of production )

(3) **Delivery** ( Both time of delivery and reliability of delivery )

(4) **Quality**

Important trade off must be made among these objectives, it is impossible for a firm to excel of them simultaneously

The manufacturing strategy making process as selected by a firm may be Incremental, Integrated or bold Then the objectives for the firm will be

| | INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|---|
| COST | High (1) | Low (2) | High (3) |
| FLEXIBILITY | High/Low (4) | High/Low (5) | High (6) |
| DELIVERY | High/Low (7) | High (8) | Low (9) |
| QUALITY | High (10) | High (11) | Low (12) |

(1) Investment in production facilities is moderate as firms pursuing this strategy making process face severe resource crunch So they do not enjoy economies of scale Per unit manufacturing cost is expected to be high

(2) Low, as economies of scale are realized

(3) High, as they go for increased capacity in all quite early and hence do not realize high capacity utilization They charge premium price

(4) They dedicate their manufacturing facilities to differentiated products which can command higher price that makes up for higher cost of production So product flexibility is high But they do not have the capability to focus on different types of products due to low investments So volume flexibility is low

(5) If they use FMS, flexibility is high But if they use mass production and high standardization in a single facility, flexibility is likely to be low

(6) They bank on new product introduction at a rapid rate for edge over competitors Simultaneously, they are ready to make large investments in manufacturing in anticipation of future demands So both product and volume flexibility is likely to be high

(7) Low production facility is compensated by keeping adequate stocks Since production plus stocks is sufficient to meet the promised deliveries, delivery is likely to be high However they can not respond to large scale changes in delivery schedules at a short notice

(8) Higher scales of production in case of old products and integrated product-process development in case of new products enable them to keep delivery high If FMS is used set up time is low

(9) Product-process development is not integrated So the process is not standardized Hence delivery is low

(10) High, as manpower is trained

(11) High, as process is automatically able to produce high quality Besides they are more likely to pursue TQM

(12) They bank more on new product introductions rather than quality People are not highly trained at all levels So quality is low

HYPOTHESIS 1: When a firm chooses "bold" manufacturing strategy, it is likely to have poor quality as it does not have much time to consolidate It should go for proven technologies and integrated product-process development to ensure high quality

Example Hewlett Packard Vs IBM

IBM went for proven technologies and captured the market over years while HP went for latest technology products and bold strategy As a result HP developed products with reliability and quality problems and could not capture the market as IBM had done

The manufacturing decisions which need to be taken to attain the decided objectives are

(1) **Organization** Level of integration, formalization, centralization and complexity

(2) **Facility** Single or multiple Size and focus of the facilities

(3) **Capacity** Level of production capacity Timing and utilization of the capacity

(4) **Vertical Integration** Decisions regarding backward and forward integration

(5) **Scope & New products** Frequency at which new products are to be introduced and how to increase the scope of their success

(6) **Process Technologies** Continuous flow, assembly line, batch or job shop production Old or new technology

(7) **Human Resources** Single or multi skilled Level of training

(8) **Vendor Relations** Cooperative or competitive vendor relation strategy

(9) **Production Planning and Inventory Control** Decisions regarding scheduling, MRP, JIT, FMS or other AMT's

To attain the manufacturing objectives decided above for various manufacturing strategy formulation processes, the decisions will be

(1) **Organization** (Reference Miller 1987)

Organization structure and strategy making are highly interdependent and must be complementary in many ways to ensure good performance Four aspects of organization structure are integration, formalization, centralization and complexity

Integrative liaison devices like task forces and coordinate committees can encourage rationality in decision making They precipitate contacts among decision makers that may motivate systematic attempts to develop, scrutinize, and reconcile divergent perspectives Integrative devices can also induce interaction Committees increase face-to-face contacts among managers They promote consultation, useful exchange of information, and worthwhile debate Integrative devices also increase assertiveness, uniting the perspectives of decision makers and emboldening them to make decisive and proactive decisions

Formalization-the use of formal procedures and job descriptions, cost and quality controls, specialists and professional technocrats increase analytical capabilities and expertise needed for systematic and overtly rational modes of decision making Specialization and technocratization involve many managers in any given issue and thus can induce highly interactive decision making Formalization of policies and procedures however reduce assertiveness People may ignore decision making stimuli that no formal system monitors so their firms respond only to obvious and pressing problems

Centralization discourages rationality by placing most of the onus of decision making on top executives It impedes analysis and planning It also diminishes a felt need for interaction by inducing conformity in methods and goals via power structures rather than through discussion Centralization can free top managers to be assertive-venturesome and proactive-because they have more power to commit significant resource to a project Miller, however noted after his analysis that centralization encourages rationality in some firms, but these firms were largely unsuccessful firms However it discourages assertiveness in most firms It is possible that assertiveness is less hazardous in the context of a decentralized structure, where decision making is a participatory endeavor

Clerical employees (complexity) contribute to rationality Some reduce the load on CEOs reducing their information overload and providing time for analysis, planning and codification of strategy Complexity contribute to organization fragmentation, which makes it difficult for a firm to achieve the consensus needed for an assertive, proactive product-market strategy Complexity has no obvious implication for interaction

On basis of the above theory proposed by Miller the organization structure for different processes of manufacturing strategy making will be-

| | INTERACTION | INTEGRATED | BOLD |
|---|---|---|---|
| Integration | High | High | High |
| Formalization | High | High | Low |
| Centralization | Low | Low/High | High/Low |
| Complexity | | High | Low |

**HYPOTHESIS 2** For high delivery formalization and centralization should be low

Less formalization reduces need for bureaucracy, reduces procedures and paperwork It gives more autonomy to production staff to take quick decisions and thus the firm is able to meet its delivery schedules Decentralization divides decision making tasks into more manageable bits, reduces collective cognitive limitations and allows more autonomy to staff to enable them to make quick decisions This again results in reliable and timely deliveries

E g GEC has to keep its delivery very high As even a slight delay in delivery of heavy electrical machinery's can cause heavy losses due to interest payments The decentralization in its plants is considerable and adequate power is rendered to personnel's even lower down the hierarchy to meet delivery schedules

(2) **Facility:**

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| Multi , as they sell differentiated products to | Single, to reap economies of scale and hence | Multi, as they generally have more than one |

| | | |
|---|---|---|
| reduce risk | investments in facilities is high | product Different facilities may focus on different product or product life cycle e g semi-conductor industry |

(3) Capacity

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| They do not keep excess capacity, instead hold seasonal inventories Capacity is more or less fully utilized | Normally integrated process of strategy making for manufacturing process is used when demand is assured Monolithic production facilities are built in face of assured demand The problem comes up when demand becomes volatile after the plant is built E g TELCO after HCV market dried up | They add capacity in anticipation of future demand (Aggressive) Full capacity utilization is seldom achieved |

(4) **Vertical Integration**

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| Low<br>As they make little investment in production facilities | High/Low<br>They may coordinate the production of independently owned suppliers with JIT system or they may go for high degree of in-house production depending upon firms capability | Low, as flexibility is of paramount importance to them<br>They have no time for vertical integration<br>They depend heavily on vendors/ suppliers |

**HYPOTHESIS 3:** For high flexibility, vertical integration should be low and when vertical integration is high flexibility is low For a firm having high vertical integration, response to volume changes is relatively poor due to enormous organization effort required It is easier for a company to change orders to independent suppliers that produce for a lot of companies It is again easier to switch suppliers in case of product/ volume changes rather than making changes in company's production line

E g DCM-Daewoo could cut its production by 50% in wake of inadequate demand as it has low vertical integration and it could cut back orders to vendors

**HYPOTHESIS 4:** For low vertical integration manufacturing cost is high and if vertical integration is high manufacturing cost is low High vertical integration is

generally expected to give higher profits to company, but at the cost of higher investments in machinery It is a open research problem to predict whether ROI is higher for high vertical integration or for low vertical integration where a firm may go into venture projects with the vendors Answer to it probably depend on different break even volume for main products and for products downstream

E g The price of aluminium manufactured by INDAL is relatively higher than that manufactured by NALCO or HINDALCO One of the important reasons for it is INDAL does not have adequate captive power capacity while the other two are self-sufficient in this respect 40% of the cost of aluminium manufactured is cost of power so vertical integration in this respect is highly essential to reduce cost

(5) **Scope and New products**

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| High, as they have multifacilities and introduce differentiated products<br>These are usually a success as not much risk is involved in differentiating a already successful product | Low, as most facilities are geared towards similar looking products | Rapid and frequent However as little time is spent in perfecting the product, there is reliability problem in the market |

(6) **Process Technologies**

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| Goes for steady improvement in technology (New) | Assembly line or FMS, as they keep cost low as well as flexibility high<br>They intake proven technologies (Old) | Small production lines or job shop approach for high flexibility<br>Adopts most modern technologies |

(7) **Human Resources**

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| Expertise at low (worker) level required Multiskilled work force as improvement comes from lower levels | As JIT, TQM are applied, workforce should be highly trained and motivated<br>Rotation of jobs<br>to improve integration | Not much time for training and upgradation Personnel policies, reward etc shunned as they reduce company's flexibility |

(8) **Vendor Relations**

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| As vertical integration is low, vendor relations is | They go for cooperative vendor relations strategy | They go for competitive vendor relations strategy |

| important However "Competitive" vendor relation may be promoted So not much investment is made on this | for flexibility with quality | for flexibility as shortage of time is there |
|---|---|---|

(9) **Production Planning and Inventory Control:**

| INCREMENTAL | INTEGRATED | BOLD |
|---|---|---|
| They hold finished goods inventories to compensate for low capacity MRP based push system is used | JIT based pull system, FMS etc | Scheduling is difficult in job shops and hence MRP is used |

## 3.2 BALANCING THE VARIOUS MANUFACTURING OBJECTIVES :

Changing market conditions usually force each plant to revise its objectives and hence a different focus is required We quote two examples from Skinner (1996) to illustrate our point

**COMPANY A :**

With sales of about $1 B, the firm produces giant electrical machinery, products which cost $100 M a piece and take three years to make and for which on-

time promised delivery had always been crucial for success After losing significant market share to foreign competitors, company A re-energized its manufacturing management, installing JIT and TQM, went heavily into "teaming", initiating literally 551 continuous improvement projects, and, using empoverment concepts, developed better union and workers relations

While market share losses slowed somewhat, the entire industry became more price sensitive and new contracts had to be bid with much lower margins Suddenly the firm began to recognize substantial overruns in labor costs relative to bid levels and by the time this was realized many millions of dollars had been lost Subsequent analysis revealed that the structure of the industry had changed and, consequently made it necessary for company A to change its competitive strategy The critical task of manufacturing had shifted from on-time delivery to low cost

**COMPANY B:**

This company produces electronic assemblies for its parent and on a contractual basis for other companies Recognizing the intensifying cost/price focus in industry, the company introduced highly automated, labor saving equipment, JIT, and TQM into a newly built, large, specialized, high volume plant to achieve economies of scale

In spite of all these modern and well-proven techniques, the operations nearly failed for one reason the equipment and the process technology was so highly automated and special purpose that it could not handle the mass of small, custom orders that predominated the work available, due to trends in industry towards shorter product lives, more customized products, lower order quantities, and intense competition

The techniques adopted by company B though impressive, failed to provide a competitive advantage Their failure to design the manufacturing processes to be appropriate to the industry and their own strategy made the plant an economic failure

The above examples amply prove the need of orienting the manufacturing for a properly decided set of objectives which are monitored from time to time Hence we propose to list the contents of manufacturing strategy for different combination of objectives in this section In the next section we propose how to reorient manufacturing to make a transition from one set of objectives to another set, when market conditions force a firm to do so

(1) **Cost-Low,** Quality-Low, Delivery-Low, Flexibility-Low

Manufacturing Strategy making process To keep the cost low, a firm should pursue integrated strategy making process with high standardization and mass production

Major Manufacturing decisions

(a) Organization High formalization, high integration and high centralization for low cost

(b) Facility Single facility with mass production

(c) Capacity High capacity for economies of scale

(d) Vertical Integration High, as flexibility is not important while cost should be low

(e) Scope & New Products Low, as product flexibility is not important

(f) Process Technologies Continuous flow process with old tested technology

(g) Human Resources Single skilled Training is not important as quality is not an important criterion

(h) Vendor Relations Not much emphasis, as vertical integration is high

(i) Production Planning and Inventory Control MRP

(2) **Cost-Low/Moderate**, Quality-Low, Delivery-Low, **Flexibility-High**

As flexibility is high, cost can not be low but at best can be moderate

Manufacturing Strategy making process To keep cost moderate and flexibility high, a firm should follow integrated strategy making process with emphasis on FMS for main product lines and incremental strategy making process for down the line products

Major Manufacturing decisions

(a) Organization High formalization, high integration and high centralization would keep cost low and flexibility high

(b) Facility Multiple flow line facilities for main products and job shops for high flexibility for down the line products

(c) Capacity Sufficient capacity for low cost with high inventory for high volume flexibility

(d) Vertical Integration Low vertical integration to keep flexibility high if flexibility is more important than cost , while high vertical integration if cost is paramount

(e) Scope & New Products High Product-process development should be integrated

(f) Process Technologies Batch type as FMS is emphasized Old tested technology

(g) Human Resources Multi skilled Training can be low as quality is less emphasized

(h) Vendor Relations Competitive vendor relation strategy for low cost

(i) Production Planning and Inventory Control JIT with more emphasis on flexibility than quality

(3) **Cost-Low**, Quality-Low, **Delivery-High**, Flexibility-Low

Manufacturing Strategy making process Integrated with more emphasis on delivery, even at the cost of quality

Major manufacturing decisions

(a) Organization Low centralization for high delivery and high formalization and high integration for low cost

(b) Facility Single facility with high standardization

(c) Capacity High capacity for economies of scale

(d) Vertical Integration High, for low cost

(e) Scope & New Products Low, as product flexibility is not important

(f) Process Technologies Assembly line with old technology

(g) Human Resources Single skilled Training can be low as quality is not important

(h) Vendor Relations As VI is high, not much emphasis However cooperative vendor relation strategy for JIT

(i) Production, Planning and Control JIT, for high delivery and low cost

(4) **Cost-Low/Moderate**, Quality-Low, **Delivery-High, Flexibility-High**

High quality and high flexibility performance at low cost is unfeasible, cost will become moderate

Manufacturing Strategy making process Integrated strategy making process with emphasis on FMS

Major manufacturing decisions

(a) Organization Low formalization and low centralization with more autonomy for decision making at lower levels

(b) Facility Multiple facilities for high product flexibility

(c) Capacity Sufficient capacity, for low cost and high inventory, for high volume flexibility and high delivery

(d) Vertical Integration Low, for high flexibility , collaborative vendor relations

(e) Scope & New Products High, with integrated product-process development

(f) Process Technologies Batch type, as both cost and flexibility are important

(g) Human Resources Multi skilled due to highly variable output

(h) Vendor Relations Cooperative vendor relation strategy for JIT

(i) Production Planning and Inventory Control JIT and FMS should be pursued

(5) **Cost-Low, Quality-High**, Delivery-Low, Flexibility-Low

Manufacturing Strategy making process Integrated strategy making process with emphasis on mass production and high standardization

Major manufacturing decisions

(a) Organization High formalization, high integration and low centralization will keep cost low and quality high

(b) Facility Single facility with high standardization

(c) Capacity High capacity for economies of scale

(d) Vertical Integration High, for low cost and check on quality

(e) Scope & New Products Low as product flexibility is not important

(f) Process Technologies Continuous flow with old, tested technology Quality is built into machines through improved tooling and fixtures etc

(g) Human Resources Single skilled with high training for high quality

(h) Vendor Relations As vertical integration is high, not much emphasis on vendor relation is required

(i) Production Planning and Inventory Control MRP TQM should also be pursued

(6) **Cost-Low/Moderate, Quality-High**, Delivery-Low, **Flexibility-High**

Cost at best can be kept moderate if both quality and flexibility are to kept high

Manufacturing Strategy making process Integrated strategy making process with emphasis on FMS with adequate standardization

Major manufacturing decisions

(a) Organization Low formalization and low centralization with more autonomy for decision making at lower levels

(b) Facility Multiple facilities for high product flexibility

(c) Capacity Medium level of production for break-even FMS for high flexibility is pursued

(d) Vertical Integration Low for high flexibility For low cost, proper vendor relations strategy should be pursued

(e) Scope & New Products High for high product flexibility

(f) Process Technologies Batch type as both cost and flexibility are important

(g) Human Resources Multi skilled for high flexibility with high training for high quality

(h) Vendor Relations Cooperative vendor relation strategy should be pursued as VI is low however quality and flexibility are to be kept high

(i) Production Planning and Inventory Control JIT

(7) **Cost-Low/Moderate, Quality-High, Delivery-High**, Flexibility-Low

Cost will become moderate if emphasis is also on quality and delivery

Manufacturing Strategy making process Integrated strategy making process with emphasis on standardization and mass production

Major manufacturing decisions

(a) Organization High formalization, high integration for high quality and low cost and low centralization for high delivery

(b) Facility Multiple flow lines with high standardization for high delivery and high quality Units making products having custom made features are job shop type

(c) Capacity High capacity for economies of scale for main products and low for down the line products

(d) Vertical Integration High for low cost

(e) Scope & New Products Low, as product flexibility is not important

(f) Process Technologies Continuous flow with old tested technology Quality is built into machines

(g) Human Resources Single skilled with high training for high quality

(h) Vendor Relations As vertical integration is high, not much emphasis on vendor relation is required

(i) Production Planning and Inventory Control JIT

(8) **Cost-Low/High, Quality-High, Delivery-High, Flexibility-High:**

If Quality and flexibility are to be high cost can not be kept low and will be high

Manufacturing Strategy making process Incremental strategy making process with high inventory for high volume flexibility and large scale changes in delivery schedule

Major manufacturing decisions

(a) Organization High formalization, high integration and decentralization for balancing all the criterion's

(b) Facility Multiple facilities for high product flexibility

(c) Capacity Sufficient capacity for economies of scale and FMS for high flexibility

(d) Vertical Integration Low for high flexibility

(e) Scope & New Products High for product flexibility Product process development should be integrated for high delivery and high quality

(f) Process Technologies Modern facilities and use of AMT's like FMS etc for high flexibility and high delivery

(g) Human Resources Multi skilled and highly trained workforce for high quality

(h) Vendor Relations Cooperative vendor relation strategy should be pursued for high delivery, high flexibility and high quality

(i) Production Planning and Inventory Control MRP for high delivery and flexibility

If cost is not an important issue for the management, it can not be treated as an independent dimension Then cost will simply be determined by the level of other objectives i e it becomes a function of quality, delivery and flexibility So other eight combinations in which cost is high are redundant Cost gets determined by the degree to which the remaining three objectives need to be achieved .

### 3.3 Decisions to be taken regarding manufacturing to go from one set of objectives to another set -:

In this section we propose, how to reorient manufacturing to make a transition from one set of objectives to another set, when market conditions force a firm to do so Twenty eight such transitions are discussed, while twenty eight other reverse transitions are possible by reversing the mentioned decisions

1 **Low cost, Low flexibility, Low quality, Low delivery to Low cost, High flexibility, Low quality, Low delivery -**

There are two types of flexibility product and volume For product flexibility strategy should be to add many general purpose machinery's to the shop floor and decentralize the operations by adding multiskilled operators Multiskilled operators would need a totally different human resource policy For volume flexibility one may have to construct flow lines or go in for specialized skilled labor & higher investment This may result in centralization

2 **Low cost, Low flexibility, Low quality, Low delivery to High cost, Low flexibility, Low quality, High delivery -**

Emphasis on high delivery means one has to now segment the production facilities to gear to a specific market segment One may now decide to have flow lines for each of its product lines to be able to focus on delivery It calls for additional investments One may have to go for centralization

3 **Low cost, Low flexibility, low quality, Low delivery to Moderate cost, Low flexibility, Low quality & High delivery -**

When an organization has to pursue the goals of high delivery & high flexibility ( volume & product ) one has to attack the high set up cost Set up cost has to be reduced to near zero Hence one has to go in for advanced manufacturing techniques Flexible manufacturing systems should be adopted Where volumes are emphasized one may go in for JIT type systems & have extensive programme for good relations with vendors There should be collaborations with vendors when product flexibility is emphasized one may go in for FMS & have competitive relations with vendors & encourage many vendors for a particular component or subassembly

4 **Low cost, Low flexibility, Low quality, Low delivery to Low cost, Low flexibility, High quality and Low delivery -**

When one has to compete on high quality, one has to go for high quality machinery with highly skilled labor and use advanced manufacturing techniques such as TQM, ISO9000 etc

5 **Low cost, Low flexibility, Low quality, Low delivery to Moderate cost, high quality, high flexibility & low delivery -**

Emphasize AMT's such as TQM, & FMS Since delivery performance need not be high, one need not have a decentralized structure & one may have extensive vertical integration Manufacturing may have to be in batch mode, multiskilled workers may be required

6 **Low cost, Low flexibility, Low quality, Low delivery to Moderate cost, Low flexibility, High quality and High delivery -**

In this situation one may be required to focus on few products & hence a few flow lines will suffice to meet our market requirements, with quality built into machines through the use of advanced tools, jigs & fixtures etc Workers may not be required to be multiskilled Extensive network of vendors & close cooperation with them is preferred Vertical integration can be only moderate

7 **Low cost, Low flexibility, Low quality, Low delivery to Low cost, High quality, High delivery, and High flexibility -**

Here organization has to apply all advanced AMT's such as TQM, FMS etc and stress for an organic structure Workers have to be multiskilled Little or no vertical integration may become necessary as it becomes difficult to coordinate jobs of various people

8 **Moderate cost, High flexibility, Low quality, Low delivery to Low cost, Low flexibility, Low quality and High delivery-**

Facility layout had FMS with generalized machinery in place with lot of autonomy at shop floor level Now with changes in objectives these expensive FMS have to be reorganized into a flow lines with more centralization High volumes may have to be stressed to decrease costs Earlier for high flexibility low vertical integration was preferred but now to reduce costs one may have to go in for vertical integration

9 **Moderate cost, High flexibility, Low quality, Low delivery to Moderate cost, Low flexibility, High delivery and High flexibility -**

Here organization was using FMS type of AMT's & was achieving high flexibility Now if high delivery is to be stressed Capacity should in little excess Products with highest volumes (relatively) should be serviced by flowlines

10 **Moderate cost, High flexibility, Low quality, Low delivery to Low cost, Low flexibility, High quality & Low delivery -**

The organization has already invested substantially in FMS to meet high flexibility requirements Now if flexibility is not important, it is a substantial loss to the organization Now since quality has become important the organization must stress quality engineering & TQM Earlier "flexibility" demanded organization to be made decentralized but now with stricter quality standards, organization can afford to be more centralized More collaborative efforts should be there now

11 **Moderate cost, High flexibility, Low quality, Low delivery to Moderate cost, High quality, High flexibility & Low deivery -**

Change is in only one dimension, that is quality Organization has to stress TQM & quality engineering Vendor relation strategy has to become more cooperative instead of competitive

12 **Moderate cost, High flexibility, low quality, low delivery to Moderate cost, Low flexibility, High quality and High delivery -**

This is again a difficult transition in objectives General capabilities of machine required as FMS kind of shop is no longer useful as now flexibility is no more important Extensive investment in these facilities becomes redundant now With more importance to delivery, one must organize for flow lines which calls for further investments Now one can go in for extensive vertical integration which helps in quick deliveries & reducing costs

13 **Moderate cost, High flexibility, Low quality, Low delivery to High cost, High quality, High delivery, and High flexibility -**

Here now along with flexibility, delivery & quality is also important One must have a plan for excess capacity of general purpose machinery's TQM & quality engineering must also be emphasized Vertical integration should be lower now Process technology should be modern Highly trained workforce is a must One must emphasize MRP systems in the production organization

14 **Low cost , Low flexibility, Low quality, High delivery to Moderate cost, Low quality, High delivery and High flexibility -**

For high delivery the earlier production set up is on flow lines, but now for high flexibility one has to organize on FMS basis Now one has to add more general purpose machines Earlier there was extensive vertical integration, now it must be de-

emphasized Work force should be multiskilled now More emphasis has to be on FMS now

15 **Low cost , Low quality, Low flexibility, High delivery to Low cost, Low flexibility, High quality & Low delivery -**

Now the organization has to stress TQM Entire organization must be developed to stress quality Advanced tools, jigs & fixtures etc must be installed Quality now has to be built into machines as organization already had a mass production kind of set ups

16 **Low cost , Low flexibility, Low quality, High delivery to Moderate cost, High quality, High flexibility & Low delivery -**

Now delivery ceases to be important & quality and flexibility have become important Now product flexibility can be supplied by appropriately designing products with similar features & appropriately stressing tool engineering, apart from emphasizing TQM & building quality into machines It is tougher to make transition to volume flexibility which would require multiple general purpose facilities to meet market demands The organization currently has mass production kind of equipment's Workers now have to become multiskilled Earlier vendor relations were collaborative, now they must become competitive With high volumes business given to vendors one can have collaborative relations but when volumes are smaller, costs are high & hence competitive vendor relations with them is preferred

17 **Low cost , Low flexibility, Low quality, High delivery to Moderate cost, Low flexibility, High quality and High delivery -**

Here quality will be stressed with more automation & quality being built into machines

18 **Low cost , Low flexibility, High delivery to High cost, High quality, High delivery, and High flexibility -**

Here now along with high delivery, flexibility also has become important along with high quality Earlier mass production was stressed With flexibility getting important for product flexibility one has stress tool engineering, design for similarity in products & stress multiple jigs & fixtures of a machine With emphasis on TQM this transition to high product flexibility with design features can be easily achieved For transition to high volume flexibility things become difficult as one is required now to have multiple facilities with general capabilities For high quality now one has to have stress on a special tooling group Now quality has to be achieved by skilled labor Vendor relations become competitive now

19 **Moderate cost, Low quality, High delivery, High flexibility to Low cost, High quality, Low flexibility & Low delivery -**

If earlier emphasis was on high delivery & high flexibility ( product ), then it would not pose much problem because one would already have a mass production kind of set up which would enable us to have low cost now For high quality we have to build quality into machines now If earlier emphasis was on high delivery and high flexibility ( volume ), then one would have had multiple manufacturing centers to achieve the same Hence, now high quality would be achieved by skills of labor also Then it would be difficult to reduce costs & compete on low cost It represents a difficult transition in objectives

20 **Moderate cost, Low quality, High delivery, High flexibility to Moderate cost, High quality, High flexibility and Low delivery-**

Here now quality is emphasized & delivery is de-emphasized Earlier firm had put in lot of money in FMS kind of machinery, which will be still useful for high flexibility but is redundant fro low delivery Firm now stresses more on TQM to achieve high quality Here also firm may choose to operate in market segments where delivery is important This is also a case where manufacturing strategy drives the corporate strategy

21 **Moderate cost, Low quality, High delivery, High flexibility to Moderate cost, Low flexibility, High quality and High delivery -**

Here again quality is emphasized & flexibility is de-emphasized Earlier firm had acquired FMS kind of technology to meet high flexibility & high delivery kind of objectives Now with no emphasis on flexibility company has to use these technologies now to meet only the objective of delivery - which can be met more cost-effectively by firms having mass production kind of setup with flow lines So this again is a difficult transition in objectives and we expect that firms manufacturing strategy shall influence its corporate strategy to a substantial extent

22 **Moderate cost, High delivery, High flexibility, Low quality to High cost, High quality, High delivery, and High flexibility -**

Here firm has to simply emphasize quality and related programs such as TQM

23 **Low cost, High quality, Low flexibility, Low delivery to Moderate cost, High quality, Low delivery and high flexibility -**

Here flexibility has become more important If volume and product flexibility is desired, one must go for a general purpose machine shop with highly skilled workers and highly competitive vendors with low vertical integration One must emphasize MRP type system also

24 **Low cost, High quality, Low flexibility, Low delivery to Moderate cost, High quality, Low flexibility and High delivery -**

Facility should be changed from single facility multiple flow line to single facility Change in emphasis from MRP to JIT

25 **Low cost, High quality, Low flexibility, Low delivery to High cost, High quality, High delivery, and High flexibility -**

Facility should be changed from single to multiple VI should be changed from high to low Scope of new products changes from low to high Process changes from continuous flow to FMS Workforce should be changed from single skilled to multi skilled Vendor relations matter as VI has become low and it should be competitive

26 **Moderate cost, High quality, High flexibility, Low delivery to Moderate cost, High quality, Low flexibility and High delivery-**

Formalization in the organization should be changed from low to high Facility should be changed from multiple to single Capacity should be changed from medium to high VI should be changed from low to high Scope of new products changes from high to low Process should be batch type to continuous flow Workforce should be changed from multiskilled to single skilled As VI becomes high, vendor relations is important now instead of competitive earlier

27 **Moderate cost, High flexibility, High quality, Low delivery to High cost, High quality, High delivery, and High flexibility -**

Formalization in the organization should be changed from low to high Process technology should be changed from old to modern Change in emphasis from JIT to MRP

# CHAPTER 4

# METHODOLOGY

To verify the propositions in section 3 3 we need to do longitudinal case studies Due to lack of time and resources, we limit ourselves to verify propositions in sections 3 1 & 3 2

The manufacturing strategy of a firm follows from it's corporate strategy (Skinner 1976) Though Hayes and Wheelwright argue that functional strategies drive corporate strategies in some cases Thus different processes of manufacturing strategy formulation can be derived from processes of corporate strategy formulation The different processes of manufacturing strategy making gives rise to different manufacturing strategy contents i e objectives and structural / infrastructural decisions

A theoretical framework for manufacturing strategy relating process to contents was prepared in the previous chapter Four propositions were also given We also gave a framework in section 3 3 about how a firm should reorient manufacturing in light of changing environment A questionnaire was prepared which has four parts The first part deciphers the corporate strategy making used by a firm The second part contained questions from which manufacturing strategy making process could be inferred The third part contained questions regarding the capabilities of manufacturing The fourth part contained questions which could infer the pattern of manufacturing choices that a company has made Some questions were subjective, while in other cases the respondents were asked to give a grading on a scale

**Management Strategy making process -:**

The literature (Miller 1987) has identified three multi faceted dimensions of strategy making process rationality, interaction and assertiveness Strategy making process is applicable in general and hence the same dimension would be applicable to area of manufacturing as well If the firm follows an 'rational' approach to manufacturing strategy making process then it would realise an integrated strategy If it followed an 'interaction' approach to manufacturing strategy making process then it would realise an incremental manufacturing strategy Similarly if the manufacturing strategy making process is bold, it would realise a bold manufacturing strategy

SCALE 1 is adopted from Miller (1987) which is used to decipher corporate strategy making process used by a firm In this part of the questionnaire (SCALE 1), queries were directed to infer the dominant dimension viz interaction, assertiveness or rationality in the corporate strategy making process of management Through this, we intended to find out whether the manufacturing strategy of the company is incremental, integrated or bold

In general rationality, suggests careful analysis of problems and opportunity, scanning of markets, methodical planning, stress on long term objectives, use of analytical tools in strategy formulation and articulating unified strategies Thus questions in the first section were directed to check all these aspects in the strategy making process of the company Interaction, suggests little analysis and formulation of strategies according to disjointed, intuitive, implicit and spontaneous process Assertiveness is concerned with the riskiness of strategy and reactiveness and proactiveness of decisions

It is seen sometimes that the manufacturing strategy making process is not the same as corporate strategy making process in some industries As the theoretical framework suggests the manufacturing strategy contents based on manufacturing strategy making process, the next part (SCALE 2) of the questionnaire asks questions to directly infer the manufacturing strategy making process Thus in this part, in general the dimensions interaction, assertiveness and rationality were checked in the field of manufacturing strategy only SCALE 3 of the questionnaire was to find out the product range of the firm It is possible that some decisions of the firm are effected due to limited or wide product range

**Competitive capability of Manufacturing -:**

An important aspect of Skinner's manufacturing strategy paradigm was "trade-offs" This aspect has even survived the onslaught of new thoughts in this field (as discussed in chapter 2) Manufacturing can simply not be designed to excel equally well in all fields Advanced manufacturing systems (AMS) have considerably enlarged the choices and scope But as all competitors adopt AMS, the company has to choose a criterion on which it intends to develop a competitive edge (Skinner 1996)

Our theoretical framework suggested possible "trade-offs" for different companies having different companies having different manufacturing strategies viz Incremental, integrated, organisation bold The questions in the fourth section (SCALE 4) of the questionnaire were intended to gain a idea about the competitive capability of manufacturing Questions were directed, to check the capability of company tocompete on basis of price/quality/delivery or flexibility On basis of the response we intended to

verify the "trade-offs" suggested by us for different manufacturing strategy making processes

**Manufacturing Structure and Infrastructure -:**

Skinner (1996) argued that manufacturing strategy is all about design Once a company has decided about the nature of competitive capability it wants to build, it should design the manufacturing organisation in such a way so as to attain the objectives Our theoretical framework suggested different structural/infrastructural decisions to attain the manufacturing task These decisions depend upon the task which in turn depended upon the manufacturing strategy making process

Questions in the fifth section (SCALE 5) of the questionnaire were intended to measure the structural/infrastructural decisions of a company Some questions were subjective while others were to be answered on a scale of 1-5 The areas covered were Organisation, Facilities, Capacity, vertical integration, Scope & new products, Process & technologies, Vendor relations, Production planning & Inventory control The propositions suggested in the theoretical framework were also intended to be verified through responses in this and previous sections of questionnaire Through the responses in this section we intended to check whether the design of manufacturing as suggested by us for different tasks, is correct or not The propositions were to be verified through questions based on organisation, vertical integration and competitive capabilities of manufacturing

**Solution Methodology -:**

We had developed a theoretical framework and hypothesis regarding processes used for manufacturing making and contents of manufacturing strategy in general To validate such a theoretical framework either case study method or questionnaire based study, method could be used As, secondary data would not have given as detailed information as wanted to gain a proper insight into a company's manufacturing strategy Questionnaire method has the advantage that it is relatively less costly than case study method Further a large sample can be surveyed in relatively less time Due to several diverse statements in the in the proposed framework, for validating most of the statements the sample size should be very large As so many case studies was not possible within the resource and time constraint, questionnaire based study method was adopted

In the questionnaire based study method, the sample size taken was small for the purpose of validating such a wide framework This was due to time and resource constraint Every attempt was however made to choose the sample companies as diverse as possible This was done to substantiate the authenticity of the new paradigm to as much extent as possible Due to the limited sample size it was possible that every aspect of the framework might not be checked But the propositions and broad structure of the process-contents relation was attempted to be validated Due to resource and time constraint most of the companies chosen in the sample were in and around Kanpur city

The companies to which the questionnaire was taken are given in Appendix A The questionnaire is given in Appendix B The responses are summarised in Appendix C Analysis of the responses is done in the next chapter

# CHAPTER 5

# ANALYSIS

An analysis of the responses & data collected through questionnaires is presented in this chapter For the purpose of statistical analysis the answers were converted into scales The analysis of the complete data is given in this chapter Section 4 1 deals with the theory of interlinked corporate & manufacturing strategy Section 4 2 deals with the analysis of objectives proposed for different manufacturing strategy making processes Section 4 3 deals with the analysis of structural/infrastructural decisions for different manufacturing strategy making processes, Section 4 4 deals with the verification of hypothesis presented in chapter 3 & Section 4 5 discusses the manufacturing strategy making, process & structural/infrastructural design for different sets of objectives

The purpose of the study conducted using questionnaire was to verify & modify wherever required the theoretical framework proposed in sections 3 1 & 3 2 Due to limited sample size (20 companies) & even less companies falling in different cells of integrated manufacturing strategy (5), incremental manufacturing strategy, and bold manufacturing strategy (7) and the nature of the theoretical framework, the use and validity of statistical tools is limited Thus most of the analysis is subjective but correlational and multiple regression analysis is used to give statistical backing wherever possible The analysis and results are simultaneously presented to give a better insight

## 5.1 Relating corporate strategy making processes to manufacturing strategy making processes -

It was argued that manufacturing strategy of a firm is derived from its corporate strategy The correlations of table 1 shows that there is a strong association between rationality in corporate strategy making and integrated manufacturing strategy and interaction in corporate strategy making and incremental manufacturing strategy The association between assertiveness in corporate strategy making and bold manufacturing strategy is relatively weak but it holds more or less

**TABLE 1**

**Correlations of Corporate & manufacturing strategy making processes**

| | |
|---|---|
| RATIONALITY & INTEGRATED | 0 793248 |
| INTERACTION & INCREMENTAL | 0 817 |
| ASSERTIVENESS & BOLD | 0 688514 |

## 5.2 Relating Manufacturing strategy making process to objectives -

Out of the 20 companies, 5 pursued integrated manufacturing strategy making process, 5 pursued incremental manufacturing strategy making process, 5 pursued incremental manufacturing strategy making process & 7 pursued bold manufacturing

strategy making process Three companies did not show strong association with any particular manufacturing strategy making process (Table 2) This was arrived at, by comparing the scores for different manufacturing strategy making processes for a company (Appendix 3)

**TABLE 2**

**Companies pursuing different manufacturing strategy making processes**

| | |
|---|---|
| Integrated ( Cell 1 ) | LML, TISCO, ICI, GEC, Injectoplast |
| Incremental ( Cell 2 ) | Bee Chems , Modern Bread, Vansal Pumps, TELCO, Ordnance Factory |
| Bold ( Cell 3 ) | Risansi Industries Ltd , Roto Pumps, Punjab Paints, Industrial Electronics, Hindustan Cables, Thermit India, Lohia Starlinger |
| Mixture | Networks, Hans Metal, Polyplex |

In section 3 1 different manufacturing objectives were proposed for different manufacturing strategy making processes Table 3 shows the mean score of the competitive capabilities of different cells of manufacturing strategy making processes

**TABLE 3**

**Mean scores for Competitive capabilities of different cells of manufacturing strategy making ( Maximum score 5; >3.5 - High, <3.5 - Low )**

| | COST (Inverse) | Flexibility | Quality | Delivery |
|---|---|---|---|---|
| Integrated | 3 6 (Weakly Low) | 3 8 ( High ) | 4 4 ( High ) | 3 6 (Weakly High ) |
| Incremental | 3 7 ( Low ) | 3 71 ( Low ) | [illegible] | 3 2 ( Low ) |
| Bold | 3 7 ( Low ) | 3 71 ( High ) | 4 35 ( High ) | 3 7 ( High ) |

Comparing the above table with the objectives proposed in section 3 2, we observe -

1) For integrated manufacturing strategy making process - Manufacturing cost is weakly low, quality is high, & delivery is high However flexibility is high instead of high/low proposed It is possible that the firms in cell 1 are pursuing FMS instead mass production and high standardisation resulting in weakly low instead of low cost and high flexibility

2) For incremental manufacturing strategy making process - Manufacturing cost is high & quality is high It was proposed that product flexibility is high and volume flexibility is low for firms using incremental process of strategy making However, with a mean score of 3 4 it is found that product flexibility is also weakly low for firms pursuing incremental process of strategy making Delivery is found to be low instead

of high/low proposed This may be due to less inventory maintained by these firms or large changes in orders taken frequently

3) For bold manufacturing strategy making process - Manufacturing cost is low as capability to compete on basis of cost is high as evident from the table It was assumed that firms using bold process of manufacturing strategy making goes for excess capacity early on & so have low capacity utilisation resulting in high product cost However inspite of high capacity (3 7, Maximum - 4), capacity utilisation is high (3 7, Maximum 4) This may be the reason for low cost It was proposed that quality is low as companies using this process of strategy making go for rapid new product introduction & workhorse is less trained However it is found that with a mean score of 2 14 ( Maximum 3 ) the frequency at which these firms introduce new products is moderate rather than high Further with a mean score of 3 (Maximum 4) the workforce is moderately trained rather than less trained So for such firms using bold process of manufacturing strategy making, quality will be high instead of low This holds at least for medium & small scale industries Delivery is found to be high instead of low If the product-process development is integrated which may be true in case of cell 3 companies, delivery will be high So firms realising bold manufacturing strategy but at the same time keeping its work force well trained, maintaining a balance between new product introduction & quality, pursuing integrated product-process development & achieving high capacity utilisation can compete on all the criterion

## 5.3 Manufacturing strategy making process & Infrastructural/Structural decisions-:

Multiple regression of strategy making on various structural & infrastructural decisions is shown in table 5 The R square for all the three regressions is considerably high ( 680512, 709871 & 720861) thus predicting the close association of the structural / infrastructural decisions & the manufacturing strategy making process The regression table gives an idea about the effect of various manufacturing decisions on the manufacturing strategy making process, whether it is incremental, bold or integrated

**TABLE 5**

x11 - Normalization, x12 - Integration, x13 - Centralization, x14 - Complexity

x2 - Capacity, x3 - Vertical Integration, x4 - Scope & New products,

x5 - Newness of production technology, x6 - Human Resources,

x7 - Vendor Relation, x8 - Production planning & Inventory control

## Integrated Manufacturing Strategy

Regression Output

| | |
|---|---|
| Constant | 2 91 |
| Std Err of Y Est | 0 78 |
| R Squared | 0 68 |
| No of Observations | 20 00 |
| Degrees of Freedom | 8 00 |

| | x11 | x12 | x13 | x14 | x2 | x3 | x4 | x5 | x6 | x7 | x8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| X Coefficient(s) | 0 66 | -0 20 | -0 20 | -0 25 | -0 18 | -0 13 | 0 15 | 0 40 | -0 16 | 0 35 | 0 31 |
| Std Er of Coef | 0 48 | 0 26 | 0 32 | 0 39 | 0 37 | 0 3 | 0 4 | 0 42 | 0 72 | 0 53 | 0 76 |

## Incremental manufacturing strategy:

Regression Output

| | |
|---|---|
| Constant | 5 65 |
| Std Err of Y Est | 0 97 |
| R Squared | 0 71 |

| | |
|---|---|
| No of Observations | 20 00 |
| Degrees of Freedom | 8 00 |

| | x11 | x12 | x13 | x14 | x2 | x3 | x4 | x5 | x6 | x7 | x8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| X Coefficient(s) | 0 88 | -0 34 | 0 31 | -0 41 | -1 42 | -0 06 | -0 07 | 0 33 | 1 01 | 0 69 | -1 90 |
| Std Err of Coef | 0 60 | 0 33 | 0 40 | 0 48 | 0 46 | 0 46 | 0 50 | 0 53 | 0 90 | 0 66 | 0 95 |

**Bold manufacturing strategy:**

Regression Output

| | |
|---|---|
| Constant | 0 12 |
| Std Err of Y Est | 0 72 |
| R Squared | 0 72 |
| No of Observations | 20 00 |
| Degrees of Freedom | 8 00 |

| | x11 | x12 | x13 | x14 | x2 | x3 | x4 | x5 | x6 | x7 | x8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| XCoefficient(s) | -0 50 | 0 34 | 0 55 | 0 00 | 0 71 | -0 08 | 0 94 | 0 20 | -0 53 | 0 12 | -0 17 |
| Std Err of Coef | 0 44 | 0 24 | 0 30 | 0 36 | 0 34 | 0 34 | 0 37 | 0 39 | 0 67 | 0 49 | 0 70 |

(i) **Organisation** - Table 6 shows the correlation between organisation structure & strategy making processes

**TABLE 6**

**Correlations between manufacturing strategy making process & organisational structure**

| | Integration | Formalization | Centralisation | Complexity |
|---|---|---|---|---|
| Incremental | 0 861639 | 0 841514 | 0 077615 | |
| Integrated | 0 246841 | 0 936997 | 0 431824 | 0 169523 |
| Bold | 0 386914 | -0 23597 | 0 327335 | -0 84414 |

Incremental strategy making process is strongly positively associated with integration & formalization in organisational structure However centralisation is not associated with the strategy making process instead of negative association proposed Integrated strategy making process is positively associated with integration, formalization, centralisation & complexity as proposed But the association is weak for integration & complexity while it is very strong for formalization Bold manufacturing strategy making process is positively correlated with integration & negatively correlated with formalization & complexity in organisational structure as proposed Centralisation is positively correlated with bold manufacturing strategy making process as originally proposed by Miller

(ii) **Facility** -

All the industries except Vansal pumps & Bee chems have multiple facilities for production These two have single facility due to economic reasons & low range of products So little relation between strategy making process and number of facilities can be proved Focus of different facilities also varies considerably from different product to different market & from different volume of production to different process

(iii) **Capacity** ( Maximum score 4 ) -

Capacity & capacity utilisation for different manufacturing strategy making processes are -

Incremental - With a mean score of 2 4 capacity is just sufficient Capacity utilisation (2 8) is considerable but not full as proposed This may be due to various constraints being faced by these firms

Integrated - With a mean score of 2 4 capacity is just sufficient & not monolithic as proposed This may be due to the reason that demand is not assured Capacity utilisation is considerable (3 2)

Bold - Capacity is excess (3 7) as proposed, however capacity utilisation is also considerable (3 7) though not full

(iv) **Vertical Integration** ( Maximum score 5 ) -

Vertical integration is moderate (2 9) and not low for incremental strategy making process It is high (3 51) for integrated strategy making process This is due to the fact that none of the companies of cell 2 are pursuing JIT Vertical integration is moderate (3) & not low for bold strategy making process As seen, if firms pursuing bold process of manufacturing strategy making give due emphasis to other manufacturing objectives besides flexibility the Vertical integration will be moderate

(v) **Scope & New products** ( Maximum score 3 ) -

Firms pursuing incremental manufacturing strategy show low (1 6) frequency of product introduction instead of high proposed The companies in cell 3 are already producing differentiated products & due to less dynamism on their part they believe in occasional introduction of new products Scope of the products when introduced is relatively high (2 3) Firms pursuing integrated manufacturing strategy making process introduce new products moderately (2 2) instead of low proposed Scope of the products is relatively high (2 2) For firms pursuing bold manufacturing strategy making process, frequency of new product introduction is moderate (2 14) instead of rapid proposed This may be due to the fact that these firms also have significant emphasis on quality maybe due to market requirements Scope of new products is relatively low (2 07) in comparison to others as proposed

(vi) **Process Technologies** (Maximum score 3) -

The work flow pattern shows little relation to strategy making process The work flow pattern is seen to be dependent highly on the product being manufactured by a firm Production technology is relatively new (1 85) though not highly modern for firms pursuing bold manufacturing strategy making This may be due to limited access or heavy investments involved which may be too much for the mostly small scale industries of cell 3 Production technology is new for firms using incremental process of manufacturing strategy making Instead of old & highly tested technology, firms using integrated process of manufacturing strategy making have relatively new (1 7) technology

(vii) **Human Resources** ( Maximum score 4 ) -

The workforce is highly skilled (3 14) ( Multi skilled for a significant percentage ) for companies using bold manufacturing strategy making process Workers are skilled (2 6) for firms pursuing integrated manufacturing strategy making process However they are skilled (semi skilled + single skilled) instead of multi skilled for firms using incremental process of manufacturing strategy making As proposed workforce is highly trained (3 4) for firms pursuing integrated manufacturing strategy making while less trained comparatively (2 2) for firms pursuing incremental process of manufacturing strategy making

(viii) **Vendor Relations** -

71% of the companies pursuing bold manufacturing strategy making favoured "competitive" vendor relation strategy 60% of the companies pursuing integrated manufacturing strategy favoured "co-operative" vendor relation strategy 80% of the companies pursuing incremental process of manufacturing strategy favoured "competitive" vendor relation strategy These are more or less in agreement with the vendor relation strategy proposed in the theoretical framework

(ix) **Production planning & Inventory control** -

Out of all the companies using bold process of manufacturing strategy making 42% increase or

decrease working shifts/workers/time to match productive capacity to variable demand 42% do scheduling as work flow pattern is not predominantly job shop type as proposed 20% of the companies pursuing incremental process of manufacturing strategy making hold finished goods inventories while 40% favour increasing or decreasing working shifts/workers/time This may be due to the fact that only the latter alternative is viable as capacity utilisation is already high as observed 80% of the companies pursuing integrated process of manufacturing strategy making do scheduling to match production capacity to variable demand Only two out of twenty companies go for JIT mainly due to different constraints A high percentage (60%) of companies pursuing integrated process of manufacturing strategy making use MRP Most (87%) of the companies pursuing bold manufacturing strategy making process & 60% of the companies using incremental process of manufacturing strategy making have classical inventory control system This reflects the limitations of most small scale industries & is thus not in agreement with our theoretical framework

## 5.4 Hypothesis verification

**Hypothesis 1** - The first hypothesis in our theoretical framework stated that for firms using bold process of making, product quality is low With a mean score of 4 35 (Maximum 5) quality is however considerably high for such companies Thus hypothesis 1 does not hold The fundamental assumption behind this hypothesis was that firms using bold process of manufacturing strategy making go for rapid new product introduction and as a result they have little or no time for consolidation due to which they develop

quality problems However medium & small industries on which predominantly this survey was conducted go only for moderate & not rapid new product introduction These companies spend adequate time for consolidation & maintaining quality

**Hypothesis 2 -** The second hypothesis stated that for high delivery, formalization & centralisation should be low Table 7 shows the correlational association between delivery & formalization and centralisation

**TABLE 7**

**Correlation between delivery & Formalization and delivery & Centralisation**

| | |
|---|---|
| Delivery & Formalization | 0 129861 |
| Delivery & Centralisation | -0 0262 |

This shows that delivery is positively associated with formalization instead of negative association as proposed Centralisation is negatively associated with delivery as proposed However the correlations are very weak & it is not possible to make any significant statement

**Hypothesis 3 -** The third hypothesis stated that for high flexibility vertical integration is low & vice versa Table 8 shows the correlational association between flexibility & vertical integration

**TABLE 8**

**Correlation between flexibility & Vertical Integration**

| | |
|---|---|
| Volume Flexibility & Vertical Integration | 0 547885 |
| Product Flexibility & Vertical Integration | 0 129347 |

This shows that there is a significant positive association between volume flexibility & vertical integration which is opposite to that proposed On basis of this it is possible to give an alternative hypothesis that , vertical integration should be high for high volume flexibility & vertical integration should be low for low volume flexibility There is a positive correlation between product flexibility and vertical integration It is however very weak to make any significant statement

Hypothesis 4 - The fourth hypothesis stated that for low vertical integration manufacturing cost is high i e the capability to compete on basis of cost is low & vice versa Table 9 shows the related correlation

**TABLE 9**

**Correlation between Capability to compete on basis of price & Vertical integration**

| | |
|---|---|
| Capability to compete on basis of price & Vertical Integration | 0 528223 |

This shows that there is a significant positive correlation between capability to compete on basis of price & vertical integration Thus hypothesis 4 is verified

## 5.5 Verification of the framework for design of manufacturing organization for different objectives -

To verify & modify section 3 2 which listed the various manufacturing structural/infrasructural decisions for different objectives, the companies were divided into different cells Each cell represented a particular set of objectives The manufacturing parameters of companies in a particular cell would give us an idea about the design of manufacturing to attain the objective being represented by that particular cell It was found that for all except two companies quality was high Even the companies pursuing bold manufacturing strategy making process showed high quality This is basically due to market requirements Thus the first two cells -

Cell 1 - Low cost, low quality, low delivery, low flexibility

Cell 2 - Low cost, low quality, low delivery, high flexibility

are empty It is thus not possible to verify the decisions regarding manufacturing to attain the objectives represented by these cells Only those results which are not in agreement with our theoretical framework are discussed in detail to explain possible reasons for the disagreement

Cell 3 - Low cost, low quality, high delivery, low flexibility

Only Polyplex pursue this objective The strategy making process of Polyplex is a mixture of incremental & integrated instead of integrated As discussed earlier even the firms using incremental strategy making do not have high cost

(1) Organization ( Maximum score 7) - Formalization (5 6) is high, integration (6) is also high while centralization (4 8) is low

(2) Facility - Multiple facilities

(3) Capacity ( Maximum score 5 ) - Capacity (4) is high

(4) Vertical Integration ( Maximum score 5 ) - Vertical integration is high (4)

(5) Scope & New products ( Maximum score 3 ) - Frequency at which new products is introduced is low (1)

(6) Process Technology - A mixture of assembly line & batch production is used instead of assembly line Further it uses relatively new technology instead of old tested one This discrepancy is due to the fact that manufacturing strategy making process is a mixture of incremental & integrated

(7) Human Resources - Work force is single skilled & moderately trained

(8) Vendor Relations - It pursues co-operative vendor relation strategy

(9) Production Planning & Inventory control - JIT & MRP is pursued

Thus there is an excellent agreement between our theoretical framework & manufacturing decisions implemented by Polyplex

Cell 4 - Low/Moderate cost, low quality, high delivery, high flexibility -

Only Kisansi industries limited pursue this objective It uses integrated process of strategy making as proposed

(1) Organization ( Maximum score 7 ) - Formalization (4 6) is low but centralization is high (5 3) instead of low proposed This is basically because hypothesis 2 linking high delivery to low centralization does not hold

(2) Facility - Multiple facilities

(3) Capacity - Sufficient capacity

(4) Vertical Integration ( Maximum score 5 ) - Vertical integration is moderate (3) and not low as proposed The alternative hypothesis 3 proposes that for high volume flexibility vertical integration is high So vertical integration should be moderate for the above set of objectives

(5) Scope & new products ( Maximum score 3 ) - Frequency at which new products is introduced is moderate (2) & not high as proposed This is due to the fact more emphasis is on delivery (5) at the cost of product flexibility (3)

(6) Process Technology - Batch production is used

(7) Human Resources ( Maximum score 4 ) - Workforce is highly skilled (3) though not multiskilled as proposed Due to this reason product flexibility is low

(8) Vendor Relations - Competitive vendor relation strategy is pursued Due to various limitations the company can not adopt JIT, so vendor relation strategy need not be co-operative

(9) Production Planning & inventory control - MRP is not used as proposed Ideally the company should go for MRP as proposed however it is still using classical inventory control system

Cell 5 - Low cost, high quality, low delivery, low flexibility -

TISCO, Roto pumps, Modern bread achieves high quality at low cost, while GEC, TELCO, Hindustan cables, & Ordnance factory achieves high quality at moderate cost Three use incremental strategy making process, two use integrated & three use incremental strategy making process Thus it is difficult to come to any conclusion regarding the manufacturing strategy making process to be adopted instead of the integrated

one proposed Average score of all the seven will be used to come to any conclusion regarding manufacturing decisions to be taken

(1) Organization ( Maximum score 7, >5 high ) - Formalization (4 45) is low, integration (4 36) is low instead of high & centralization (3 9) is low Thus even though integration should be high, it is showing little effect on cost & quality

(2) Facility - All the companies use multiple facilities instead of single This is due to constraints imposed by wide product range

(3) Capacity ( Maximum score 5 ) - Capacity is moderate (2 5) instead of high This results in moderate instead of low cost for four out of seven companies

(4) Vertical Integration ( Maximum score 5 ) - Vertical integration is moderate (2 9) instead of high This again results in moderate instead of low cost

(5) Scope & New Products ( Maximum score 3 ) - Frequency of new product introduction is low (1 7)

(6) Process Technology ( Maximum score 4 ) - Work flow patterns are of different types according to products of the company technology (1 9) is relatively old & tested

(7) Human Resources ( Maximum score 4 ) - In four out of seven companies workforce is single skilled while in only one it is multiskilled Workforce is relatively highly trained (3)

(8) Vendor Relations - Five companies follow competitive vendor relations & two follow co-operative vendor relations strategy As vertical integration is not high but moderate so vendor relations matter

(9) Production Planning & Inventory control - Out of the seven , three use MRP while other four use classical inventory control system because of their limitations

Cell 6 - Low/Moderate cost, high quality, low delivery, high flexibility

Vansal pumps, LML & Industrial Electronics achieve high quality & high flexibility at low cost Again the strategy making process in all the three is different

(1) Organization ( Maximum score 7 ) - Formalization (4 1) is low & centralization (3 9) is also low

(2) Facility - Vansal pumps has single facility instead of multiple so its product flexibility is low ( 3 , Maximum 5 ) while volume flexibility is very high ( 5 , Maximum 5 ) Rest of the companies have multiple facilities

(3) Capacity ( Maximum score 5 ) - Capacity is moderate (3) as proposed

(4) Vertical Integration ( Maximum score 5 ) - Vertical integration is moderate (3 8) instead of low as proposed This again is due to the fact that hypothesis 3 does not hold

(5) Scope & New products - It is high for Industrial electronics & LML as proposed low for Vansal which has low product flexibility ( 2 , Maximum 5 )

(6) Process Technology - Two companies use batch production while LML achieves high flexibility inspite of assembly line production due to foreign collaborations

(7) Human Resources - Workforce is semiskilled in Industrial electronics & Vansal as they are basically small scale LML again has a majority of single skilled workforce Thus workforce is not at all multiskilled as proposed inspite of high flexibility In two out of three companies, workers are highly trained while Vansal pumps impart less training The workforce should however be highly trained in big industries like LML for proper quality control

(8) Vendor Relations - Vansal pump pursues competitive instead of co-operative vendor relations strategy However the other two pursue co-operative vendor relations strategy as proposed

(9) Production planning & Inventory control - JIT is not pursued by any of the companies because of various limitations

Cell 7 - Low/Moderate cost, high quality, high delivery, low flexibility

Only Hans metal pursue this objective The manufacturing strategy making process is a mixture of integrated & bold As discussed in section 5 2 quality is high for bold strategy making process also

(1) Organization ( Maximum score 7 ) - Formalization is low (4 4) Integration is low (3 3) Centralization is high (5 3) This is completely different from what was proposed in the theoretical framework It is however difficult to come to any conclusion on basis of only one company

(2) Facility - Multiple facilities

(3) Capacity ( Maximum score 5 ) - Moderate (3) capacity

(4) Vertical Integration ( Maximum score 5 ) - Very low vertical integration (1 3) This is opposite to what proposed The low score for vertical integration is basically due to low forward vertical integration as the final product of the company is metal only

(5) Scope & New products ( Maximum score 3 ) - This is low (1) as proposed

(6) Process Technology ( Maximum score 3 ) - Job shop with relatively new (2) technology This is not in agreement with the continuous flow with old & highly tested technology proposed One reason for this discrepancy may be high existing product range

(7) Human Resources ( Maximum score 4 ) - Single skilled but less trained (1) highly trained, workforce

(8) Vendor Relations - Competitive vendor relations strategy

(9) Production planning & Inventory control - JIT is not pursued

There is a high disagreement between what was proposed & what occurs in Hans metal However with the help of only one case it is very difficult to come to any conclusion

Cell 8 - Moderate cost, high quality, high delivery, high flexibility

Thermit India Ltd , Punjab Paints, Lohia Starlinger, Injectoplast, Networks achieve all the objectives at low cost ICI & Bee Chemicals achieve the objectives at moderate cost

Again not a single strategy making process is favored instead of incremental

(1) Organization ( Maximum score 7 ) - High (5 25) formalization, high (5 2) integration, & low centralization (4 2) All in excellent agreement with that proposed

(2) Facility - Multiple facilities

(3) Capacity ( maximum score 5 ) - It is sufficiently high (3 2) No information about FMS

(4) Vertical Integration ( Maximum score 5 ) - It is low (3)

(5) Scope & New products - It is more than moderate (2 2) Product-process development is also considerably integrated (2 1)

(6) Process Technology It is not modern but relatively new (1 8) This may be due to the fact that very few firms overall had modern technology

(7) Human Resources - In 33% companies workforce is multiskilled as proposed In rest of the companies it is skilled & semi skilled Considerably trained (2 8)

(8) Vendor Relations - 33% follow co-operative as proposed while others have competitive vendor relations strategy

(9) Production Planning & Inventory control - 50 % of the companies use MRP Others use classical inventory control system because of various limitations

The results of the analysis can be summarized as -

(1) The processes of manufacturing strategy making are derived from processes of corporate strategy making as proposed

(2) The manufacturing objectives for integrated & incremental strategy making processes are more or less verified with minor modifications However the objectives for bold strategy making firm was proposed basically for large firms & MNC's So the data showed considerable disagreement with the proposed framework So for small & medium scale industries the manufacturing objectives need to be modified

(3) The manufacturing decisions proposed were verified to a large extent Some modifications were proposed wherever necessary

(4) The first hypothesis does not hold For small scale industries at least the converse infect holds The second hypothesis could not be verified as correlations are weak An alternative hypothesis is in place of third is proposed The fourth hypothesis was verified

(5) Due to less sample size all the cells of different manufacturing objectives were not filled & other had less companies So section 3 2 could be verified to a limited extent

# CHAPTER 6

## LIMITATIONS OF THE STUDY & SCOPE FOR FUTURE WORK

Every attempt was made to make the present work devoid of errors However any work of such wide magnitude and to be carried within limited time & resource constraint suffers from some shortcomings The theoretical framework did not propose how to fit the various advanced manufacturing techniques as a part of manufacturing design The framework covered a wide area, from proposing contents of manufacturing strategy for different processes of manufacturing strategy to proposing possible objectives & designing manufacturing to meet those objectives At last reorienting manufacturing due to changed focus objective was discussed A result of such wide coverage was, the different areas could not be studied & explained in detail For example it is still difficult for a practising manager to design his manufacturing organisation on basis of the brief outline presented by us

The number of companies visited to verify our theoretical prepositions were few As only twenty companies were visited, the number of companies falling in different cells for verifying both sections 3 1 & 3 2 were few Three cells of manufacturing objectives of section 3 2 were empty & so manufacturing decisions for these objectives could not be verified Further vigorous statistical analysis could not be carried for the rest of theoretical framework Section 3 3 is very difficult to be verified & a thorough search of companies who have refocussed their manufacturing will have to be carried out to verify it Some error is bound to creep into the analysis as most managers tend to downplay their weak points & amplify their strong points As it is very difficult to cross check such information from other sources , there is bound to be

some faults in the picture drawn Inspite of all these limitations, the work carries significant authenticity however an attempt can be made by any future work in this field to take all these factors into account

Manufacturing strategy is a rapidly expanding field nowadays & scope for future work is manifold As three different areas were covered in this work, the framework lacked in details Future works which can be done are -

(1) Case studies can be carried out to study the design of manufacturing organisation in detail for different sets of objectives

(2) Frameworks can be prepared for linking the manufacturing functional area to other functional areas like marketing, R&D etc as a part of overall corporate strategy

(3) Case studies can be carried out to study in detail, how the manufacturing should be redesigned when a firm decides to change it's focus

# APPENDIX A

## LIST OF COMPANIES

1 ICI

2 GEC

3 LML

4 TISCO

5 RISANSI INDUSTRIES LTD

6 HANS METAL

7 LOHIA STARLINGER LTD

8 ROTO PUMPS

9 PUNJAB PAINTS

10 ORDNANCE FACTORY

11 MODERN BREAD

12 NETWORKS

13 INDUSTRIAL ELECTRONICS

14 VANSAL & VANSAL

15 POLYPLEX

16 BEE CHEMS

17 HAL LKO

18 TELCO

19 THERMIT INDIA LTD

20 INJECTOPLAST

# APPENDIX B

## QUESTIONNAIRE

## SCALE 1

**Scale for deciphering corporate strategy making process used -**

*Instruction*
Given below are some statements indicating how managers go about to make strategies Your task is to indicate the extent to which you generally employ the strategies given in each statement by writing an appropriate number as directed

*A.* For items 1 to 4 write a number between 1 and 7 such that, *1 = used rarely* and *7 = used frequently* with intermediate numbers representing appropriate level of use

*1* Do you apply operations research techniques, such as linear programming and simulation to make major production, marketing, and financial decisions ------

*2* Do you resort to periodic brain storming by senior management groups for novel solutions to problems -----

*3* Do you have formalized, systematic search for and evaluation of opportunities or accquisitions, new investments, new markets, etc -----

*4* Do you make use of staff specialists to investigate and write report on major decisions --

*B* For item 5 use scale between 1 to 7 such that, *1 = Choices among strategic alternatives tend very often to be made quickly and without precision as time pressures are often substantial and 7 = Much thought and analysis enter into key decisions*

*5* How are the key management decisions made? ------

*C.* For items 6 use scale between 1 to 7 such that, *1 = Management time is consumed by decisions aimed at its resolution and 7 = Management time is consumed by decisions aimed at exploiting opportunities in the environment*

6 How is management time consumed ? ------

*D* For items 7 use scale between 1 to 7 such that, *1 = Emphasis on bird in hand on management decisions for immediate future, 4 = Medium term orientation & 7 = Long term (over five years) goals and strategies are emphasized.*

7 What is the orientation of the management ? -------

*E* For item no 8 give a response between 1 and 7 such that, *1 = Planning done very rarely or haphazardly and 7 = Planning done very frequently and intensively*

*8* How is planning done by the top management for long term investments, forecasting of sales, nature of markets, technology etc ------

*F* Indicate by choosing a number between 1 and 7 such that, *1 = There is no explicit conceptualization and 7 = Strategies are well and precisely conceptualized and guide the modus operandi and decisions*

*9* The extent to which there is explicit conceptualization of administrative and product market strategies ------

*G* For items 10 to 13 write a number between 1 to 7 such that, *1 = not ever used* and *7 = used extremely frequently*

*10* Routine gathering of opinions from clients ------

*11* Explicit tracking of policies and tactics of competitors ------

*12* Forecasting sales, customer preferences, technology, etc ------

*13* Special market research studies ------

*H* Give a response between 1 & 7 such that, *1 = we employ consesus oriented team decision making* and *7 = decisions are made by managers individually without much interaction*

*14* The extent to which consensus versus individual decision making is used for strategic decisions -----

*I* Use the scale *1 = not very important, 2 = moderately important & 3 = extremely important* for item number 15

*15* How important is bargaining and discussion for middle and top management in the resolution of problems, conflicts or decisions ? -----

*J.* Use the scale *1 = there is a strong tendency to follow competitors in introducing new things and ideas, 7 = we always try to be ahead of competition in product novelty or speed of innovation and usually succeed*

*16* Are you a leader or a follower in the market ? -----

*K* Use the scale *1 = we favor tried and true methods, 7 = we are growth, innovation, development oriented.*

*17* How bold are you compared to other competitors in the market? -----

*L* Use the scale *1 = we try to cooperate and co-exist with competitors, 7 = we pursue a tough "undo-the-competitors" philosophy*

*18* How aggressive are you in the market? -----

*M* Use the scale *1 = there is a strong productivity towards low rise projects (with normal and certain rates of return), 7 = the firm has strong productivity for high rise projects (with chances of high returns)*

*19* What is the extent to which your firm takes risks? -----

*N* Use the scale *1 = it is best to explore the environment gradually via timid, incremental behaviour, 7 = it is best to explore the environment in a bold manner, wide ranging acts are viewed as useful and common practice*

*20* What is the nature of your behaviour in the context of environment? -----

## SCALE 2

**Scale for deciphering manufacturing strategy making process used -**

***Instruction***

Given below are some statements indicating how manufacturing managers go about to make strategies Your task is to indicate the extent to which you generally employ the strategies given in each statement by writing an appropriate number as directed

*A.* For items 1 to 4 write a number between 1 and 7 such that, *1 = used rarely* and *7 = used frequently* with intermediate numbers representing appropriate level of use

*1* Do you apply operations research techniques, such as linear programming and simulation to make major production decisions ------

*2* Do you resort to periodic brain storming by senior production personnels for novel solutions to problems ------

*3.* Do you have formalized, systematic search for and evaluation of opportunities or accquisitions, new investments etc in manufacturing ------

*4* Do you make use of staff specialists to investigate and write report on major manufacturing related decisions ------

*5* Do you use advanced manufacturing techniques such as MRP, JIT, TQM etc

*B.* For item 6 use scale between 1 to 7, such that *1 = Choices among strategic alternatives tend very often to be made quickly and without precision as time pressures are often substantial and 7 = Much thought and analysis enter into key decisions*

*6.* How are the key manufacturing related decisions made? ------

*C.* For item 7 indicate on a scale between 1 & 7 such that, 1 = *Management time is consumed by decisions aimed at its resolution and 7 = Management time is consumed by decisions aimed at exploiting new opportunities*

7 How is management time consumed ? ------

*D.* For item 8 indicate on a scale between 1 & 7 such that, *1 = Emphasis on short term decisions, 4 = Medium term orientation & 7 = Long term (over five years) goals and strategies are emphasized*

8 What is the orientation of the manufacturing management ? ------

*E* For item no 9 give a response between 1 and 7 such that, *1 = Planning done very rarely or haphazardly and 7 = Planning done very frequently and intensively*

9 How is planning for long term investments in manufacturing, forecasting of technology relevant to products etc done by the manufacturing management ?
------

*F.* For items 10 to 11 write a number between 1 to 7 such that, *1 = not ever used* and *7 = used extremely frequently*

*10* Routine gathering of opinions from workers regarding processes, tools and other suggestions regarding manufacturing ------

*11* Explicit tracking of manufacturing policies and tactics of competitors ------

*G* Use the scale, *1 = we employ consesus oriented team decision making*, and *7 = decisions are made by managers individually without much interaction*

12 The extent to which consensus versus individual decision making is used for strategic decisions in manufacturing -----

*H* Use the scale, *1 = not very important, 2 = moderately important & 3 = extremely important* for item number 15

13 How important is bargaining and discussion for middle and top management in the resolution of manufacturing related problems, conflicts or decisions ?
------

*I* Use the scale, *1 = there is a strong tendency to follow competitors in introducing new things and ideas, 7 = we always try to be ahead of competition in product novelty or speed of innovation and usually succeed.*

*14* Are you a leader or a follower in the manufacturing technology / process use
-----

*J.* Use the scale, *1 = we favor tried and true methods in manufacturing, 7 = we are growth, innovation & development oriented in manufacturing*

15 How bold are you compared to other competitors in relation to manufacturing investments? ------

*K* Use the scale *1 = we try to cooperate and co-exist with competitors regarding our manufacturing policy, 7 = we pursue a tough "undo-the-competitors" philosophy in manufacturing*

*16* How aggresive are you in the field of manufacturing? ------

*L.* Use the scale *1 = there is a strong productivity towards low rise (with normal and certain rates of return) projects in manufacturing, 7 = the firm has strong productivity for high rise (with chances of high returns) projects in manufacturing*

17 What is the extent to which your firm takes risks in relation to manufacturing investments? ------

*M.* Use the scale *1 = It is best to make small, incremental investments, technology related decisions in manufacturing, 7 = It is best to be bold in manufacturing related decisions & wide ranging acts in manufacturing are viewed as useful and common practice*

*18* What is the nature of your behaviour in above context -------

## SCALE 3

**Scale for finding out the product range -**

1 The number of products/assemblies manufactured by your firm -
(a) 1 (b) 2 (c) 3 (d) 4 (e) 5 (f) >5 (Specify)
2 The variety of products/assemblies manufactured on a scale of 1-5- ☐
1- Almost same type of products
5- Highly diverse products

## SCALE 4

**To decipher the manufacturing objectives stressed by firms -**

***Instruction***
On a scale of 1-5 - (1) Low (Not a issue for your manufacturing) (2) Somewhat (Lower than most others in industry) (3) Moderate (comparable to most others in industry) (4) High (comparable to best in industry) (5) Very high (leader in the market)

**(1)** Your capability to compete on price - ☐
**(2)** Your capability to make rapid design changes and/or introduce new products rapidly - ☐
**(3)** Your capability to respond to swings in volume - ☐
**(4)** Your capability to offer consistent quality - ☐
**(5)** Your capability to provide high performance products - ☐
**(6)** Your capability to deliver products quickly - ☐

(7) Your capability to deliver on time (as promised) - ☐

## SCALE 5

**To measure the structural/infrastructural decisions -**

**ORGANIZATION -**

**Instruction :**

Given below are some statements meant to study the structure of your organisation You are to indicate the extent to which your organisation employ each statements by writing an appropriate number as directed

*1 Extent of reliance on personnel and decision making* -------
1 = great reliance on personnel with experience and common sense
7 = great reliance on specialized,technically trained line and staff personnel

*2 The level of formal technical competence of first line superior required* ----
1 = no training beyond high school
2 = varies considerably by functional areas
7 = a minimum of a bachelor degree with specialization

*3 Percentage of professionals such as engineers,scientists and accountants employed in your organisation* ------
1 = few (less than one percent of those other than first line)
4 = about 5%
7 = many (20% of the employees other than first line production workers )

*4 Indicate the extent* to which your organisation uses integrative mechanisms like interdepartmental committees, task forces, liason personnels etc to assure compatabilities among decisions in one area (for example marketing ) with those in other area (for example production ) ——
*1 = used rarely & 7 = used very frequently*

*5. Indicate the extent* to which participation , cross functional discussions characterise decision making at the top level in your organisation regarding product or service decisions concerning production, marketing and R&D, long term investment decisions, and growth or diversificationn strategies ——
*1 = rare use of committees or infrequent informal collaborration*
*7 = frequent use of committies of informal interdepartmental collaborration*

6. What is the extent of interdepartmental interaction in your organisation -----
*1= each depar tment makes decision more or less on its own,without regards to other departments*
*7=there is a great deal of departmental consensus on most decisions*

**In items number** 7 to 12 ,use the following scale
*1 = used rarely or for small part of operation*

*7 = used frequently or throughout the firm*

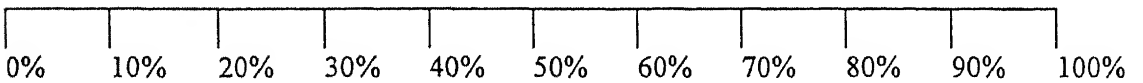
*7.* My organisation has a comprehensive management control and information system ------
*8.* My organisaton has a cost centres for cost controls -------
*9* My organisaton has profit centres and well defined profit targets -------
*10* My organisaton ensures quality control of operations via sampling and other techniques --
-
*11* My organisation employs cost control by fixing standard cost and by analysing variations
------
*12* My organisation has an established system of formal appraisal of personnel ----
*13.* What is the extent of mechanisation of production in your organisation -----
*1 = manual production & 5 = fully automated production*
*14. Provide the following information*
(a) No of operating sites of the organisation ------
(b) Proportion of managerial peresonnel to total personnel -----
(include all levels of management including foremen)
(c) Proportion of clerks to total personnel ------
(clerks are staff in all functional areas who are not directly engaged in making, designing or selling the product)
(d) Number of levels in the organisation -------
(count the number of levels in the largest line between direct workers and the chief executive)

**FACILITY** - Please indicate-

**(1)** Number of facilities for production in your firm -
(a) Single (b) Multiple
**(2)** If multiple, focus of different facilities is according to -
(a) Different volume of production (b) Different product (c) Different market
(d) Different process

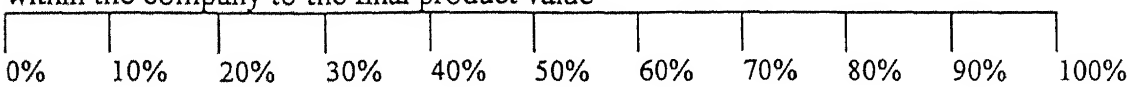
**CAPACITY** - Please indicate -

**(1)** For your major products, the production capacity to meet the customer demand is -
(a) Sufficient to meet the present and future (2-3 yrs )demand (Excess capacity)
(b) Sufficient to meet just the present demand (Sufficient capacity)
(c) Insufficient to meet the present demand during some seasons (Moderate capacity)
(d) Insufficient, resulting in late deliveries during most of the year (Low capacity)
**(2)** For your major production lines, the percentage capacity utilization is -

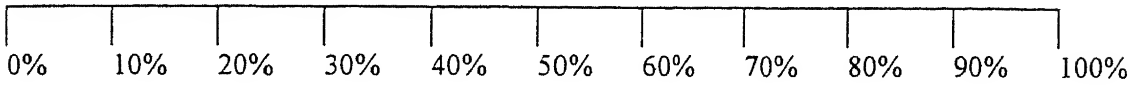



**VERTICAL INTEGRATION** - Please indicate-

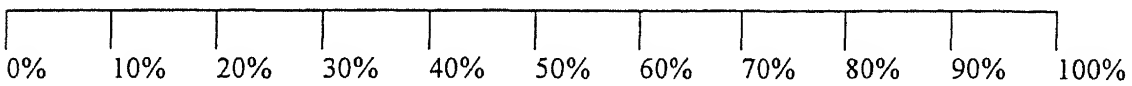
**(1)** For your major products, please mention the percentage of value added within the company to the final product value -



(2) Excluding sales tax, what percentage of the final consumer price is given to the outside trade channels -




(3) For your major products the cost of assemblies purchased as a percentage of cost of goods sold -




**SCOPE AND NEW PRODUCTS** - Please indicate-

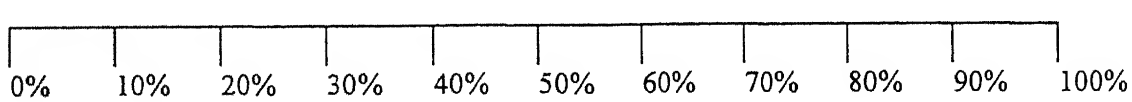
(1) The frequency at which your firm introduces new products in the market-
(a) Low ( Maximum preference for remaining with established products )
(b) Somewhat (Occasional introduction of new products )
(c) Moderate (At par with many others in the industry )
(d) High (More than many others in the industry )
(e) Very high ( Best in the industry )
(2) A manufacturing representative is required to sign-off on design reviews for new products -
(a)Yes (b) No (c) Something like that (Some discussion is there )
(3) Job rotation between design and manufacturing engineering is practiced -
(a)Yes (b) No (c) Somewhat

**PROCESS AND TECHNOLOGIES** - Please indicate -

(1) The work flow pattern in your firm may be considered as-
(a) Project type (b) Job shop (c) Batch (d) Assembly line (e) Continuous flow
(f) None of these ( Please specify, briefly )
(2) Your production technology is -
(a) Most modern in the industry (b) Relatively new (c) Old and highly tested

**HUMAN RESOURCES** - Please indicate -

(1) Majority of workers in your firm are -
(a) Unskilled (b) Semi-skilled (c) Single skilled (d) Multi skilled
(2) The amount of formal training provided by your firm to a employee apart from regular work throughout his tenure is -
(a) Low (b) Somewhat (c) Moderate (d) High (e) Very high
(3) Salaries as a percentage of cost of sales -




**VENDOR RELATIONS** - Please indicate -

(1) How many vendors for a particular assembly/product are there-
(a) 1 (b) 2 (c) 3 (d) 4 (e)>4 (Specify)

**(2)** Your firm will consider the vendor relations strategy followed by it as -
(a) Vendors not important, so no intended policy as such
(b) Co-operative (i e importance to joint vendor development programme or other help to vendors)
(c) Competitive (i e vendor is selected based on cost, delivery requirement etc resulting in changed vendors from time to time )
(d) None of these ( Please specify, briefly )

**PPC AND INVENTORY CONTROL** - Please specify-

**(1)** To match productive capacity to variable demand over medium term planning horizon (12-18 months), you rely on-
(a) Scheduling (b) Build up or run down finished goods inventories (c) Increase or decrease working shifts/workers/time (d) Any other ( please specify )
**(2)** Does your firm pursue any particular scheme for inventory management Such as-
(a) MRP (b) JIT (c) Classical, production and inventory system
(d) any other ( Please specify, briefly )
**(3)** On line data processing, automation etc -
(a) Low (b) Somewhat (b) Moderate (d) High (e) Very high

## APPENDIX C

## DATA

**Variables Assigned :**

1 Corporate strategy making process - a ( Maximum scale 7 )

Rationality - a1

Interaction - a2

Assertiveness - a3

2 Manufacturing strategy making process - y ( Maximum scale 7 )

Integrated - y1

Incremental - y2

Bold - y3

3 Product range - b

Number of products/assemblies manufactured - b1

Product range - b2 ( Maximum scale 5 )

4 Manufacturing objectives - z ( Maximum scale 5 )

Low cost - z1

Product flexibility - z21, Volume flexibility - z21, Flexibility - z2

Quality - z3

Delivery - z4

5 Structural/Infrastructural decisions - x

(i) Organisation - x1 ( Maximum scale 7 )

Formalization - x11

Integration - x12

Centralisation - x13

Complexity - x14

(ii) Facilities - Subjective

(iii) Capacity - x2 ( Maximum scale 4 )

Production capacity - x21

Capacity utilisation - x22

(iv) Vertical Integration -x3 ( Maximum scale 10 )

(v) Scope & New products - x4 ( Maximum scale 5)

Frequency of new product introduction - x41

Scope - x42

(vi) Process & Technology -

Work flow pattern - Subjective

Newness of production technology - x5 ( Maximum scale 3 )

(vii) Human Resources - x6 ( Maximum scale 4 )

Skill - x61

Training - x62

Salaries - x63

(viii) Vendor relations -

Number of vendors - Subjective

Vendor relations - x7 ( Maximum scale 3 )

(ix) PPC & Inventory control - x8 ( Maximum scale 3 )

PPC - x81

Inventory control - x82

On line data processing, automation etc - x83

## THE CODED RESPONSES

| Name | a1 | a2 | a3 | y1 | y2 | y3 | b1 |
|---|---|---|---|---|---|---|---|
| Risansi | 4 5 | 4 5 | 5 4 | 3 5 | 4 | 5 6 | >5 |
| Roto | 4 5 | 4 5 | 5 8 | 2 9 | 4 | 5 6 | >5 |
| Pjb Paint | 3 6 | 3 5 | 4 4 | 3 5 | 3 5 | 4 5 | 4 |
| Ind Elec | 2 9 | 3 5 | 6 2 | 4 | 3 | 5 4 | >5 |
| Hind Cab | 3 9 | 3 | 3 6 | 4 6 | 4 | 5 4 | 10 |
| Thermit | 4 2 | 3 | 5 8 | 4 1 | 3 2 | 5 5 | 6 |
| Starlinger | 5 8 | 4 | 6 2 | 5 1 | 3 | 5 6 | 12 |
| LML | 5 6 | 5 5 | 3 6 | 5 5 | 4 5 | 4 6 | 1 |
| TISCO | 6 4 | 5 | 3 8 | 5 5 | 5 | 4 | 5 |
| ICI | 5 5 | 4 | 5 | 5 4 | 3 5 | 4 8 | >5 |
| GEC | 4 5 | 4 | 4 | 4 1 | 3 5 | 3 6 | 12 |
| Inject | 5 5 | 3 | 5 | 5 6 | 2 5 | 4 4 | >5 |
| Bee Chems | 4 | 6 | 4 | 3 9 | 5 5 | 4 8 | 2 |
| Mod Bread | 4 15 | 6 | 4 2 | 4 1 | 5 5 | 4 2 | 3 |
| Vansal | 2 6 | 6 | 5 6 | 3 | 7 | 6 | >5 |
| TELCO | 4 2 | 4 | 5 4 | 4 9 | 5 5 | 3 3 | >5 |
| Ordnance | 2 5 | 2.5 | 2 | 2 6 | 3 | 2 6 | 5 |
| Networks | 5 | 4 | 4 4 | 4 3 | 4 | 4 4 | >5 |
| Hans Met | 4 5 | 2 5 | 5 8 | 4 8 | 2 5 | 5 | 6 |
| Polyplex | 4 1 | 4 5 | 4 | 4 15 | 3 5 | 4 | >5 |

| Name | b2 | z1 | z21 | z22 | z3 | z4 | x11 | x12 |
|---|---|---|---|---|---|---|---|---|
| Rısansı | 4 | 4 | 3 | 5 | 3 5 | 5 | 4 6 | 5 |
| Roto | 5 | 4 | 4 | 3 | 4 | 3 | 4 | 6 3 |
| Pjb Paınt | 4 | 4 | 4 | 5 | 5 | 4 | 4 8 | 3 |
| Ind Elec | 3 | 4 | 5 | 3 | 4 | 3 5 | 1 6 | 1 |
| Hınd Cab | 1 | 2 | 1 | 2 | 4 | 2 5 | 4 9 | 3 3 |
| Thermıt | 3 | 4 | 3 | 5 | 5 | 4 | 4 | 4 |
| Starlınger | 3 | 4 | 4 | 5 | 5 | 4 | 6 | 7 |
| LML | 3 | 4 | 5 | 3 | 4 5 | 3 5 | 6 | 6 3 |
| TISCO | 2 | 4 | 3 | 3 | 4 5 | 3 5 | 5 6 | 6 |
| ICI | 5 | 3 | 5 | 5 | 5 | 4 | 5 9 | 7 |
| GEC | 4 | 3 | 2 | 2 | 4 | 2 5 | 4 9 | 5 3 |
| Inject | 5 | 4 | 5 | 5 | 4 | 4 5 | 5 9 | 4 7 |
| Bee Chems | 2 | 3 | 4 | 5 | 4 5 | 4 | 5 2 | 5 4 |
| Mod Bread | 2 | 4 | 3 | 4 | 4 | 3 5 | 4 6 | 5 |
| Vansal | 3 | 5 | 5 | 3 | 4 5 | 2 5 | 4 7 | 5 7 |
| TELCO | 3 | 2 | 4 | 2 | 4 5 | 3 | 4 9 | 3 67 |
| Ordnance | 3 | 2 | 1 | 3 | 4 | 3 | 2 3 | 2 7 |
| Networks | 5 | 5 | 5 | 4 | 5 | 5 | 5 6 | 4 7 |
| Hans Met | 3 | 4 | 1 | 3 | 4 | 4 | 4 4 | 3 3 |
| Polyplex | 3 | 5 | 2 | 3 | 3 | 4 5 | 5 6 | 6 |

| Name | x13 | x14 | x21 | x22 | x2 | x3 | x41 | x42 |
|---|---|---|---|---|---|---|---|---|
| Rısansı | 5 3 | 4 | 4 | 3 | 3 5 | 3 | 2 | 2 5 |
| Roto | 4 5 | 5 | 3 | 4 | 3 5 | 3 6 | 3 | 1 5 |
| Pjb Paınt | 3 6 | 4 | 4 | 5 | 4 5 | 2 85 | 2 | 2 |
| Ind Elec | 1 7 | 3 | 3 | 4 | 3 5 | 3 5 | 3 | 3 |
| Hınd Cab | 5 3 | 5 | 4 | 4 | 4 | 2 4 | 1 | 1 5 |
| Thermıt | 5 6 | 4 | 4 | 3 | 3 5 | 3 5 | 1 | 1 |
| Starlınger | 3 4 | 4 | 4 | 3 | 3 5 | 2 25 | 3 | 3 |
| LML | 4 1 | 4 | 3 | 3 | 3 | 4 15 | 3 | 2 5 |
| TISCO | 4 3 | 5 | 3 | 3 | 3 | 3 75 | 1 | 2 |
| ICI | 3 6 | 5 | 2 | 3 | 2 5 | 3 | 3 | 2 |
| GEC | 3 8 | 6 | 1 | 3 | 2 | 2 4 | 2 | 2 |
| Inject | 4 1 | 4 | 3 | 4 | 3 5 | 4 25 | 2 | 2 5 |
| Bee Chems | 5 5 | 5 | 2 | 3 | 2 5 | 2 75 | 1 | 3 |
| Mod Bread | 4 8 | 4 | 2 | 4 | 3 | 3 | 1 | 3 |
| Vansal | 6 | 4 | 3 | 2 | 2 5 | 3 65 | 2 | 1 5 |
| TELCO | 4 3 | 4 | 1 | 3 | 2 | 2 5 | 3 | 2 5 |
| Ordnance | 2 2 | 4 | 4 | 2 | 3 | 2 6 | 1 | 1 5 |
| Networks | 3 6 | 5 | 3 | 4 | 3 5 | 3 65 | 3 | 1 5 |
| Hans Met | 5 3 | 5 | 3 | 4 | 3 5 | 1 35 | 1 | 2 |
| Polyplex | 4 8 | 4 | 4 | 4 | 4 | 4 1 | 1 | |

| Name | x4 | x5 | x61 | x62 | x63 | x6 | x7 | x81 | x82 | x83 | x8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Risansi | 2 25 | 1 | 3 | 4 | 2 | 3 | 2 | 3 | 1 | 1 | 1 7 |
| Roto | 2 25 | 3 | 4 | 3 | 2 | 3 | 2 | 1 5 | 1 | 2 | 1 5 |
| Pjb Paint | 2 | 1 | 2 | 1 | 1 | 1 7 | 2 | 1 | 1 | 1 | 1 |
| Ind Elec | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 1 |
| Hind Cab | 1 25 | 3 | 3 | 3 | 2 | 2 7 | 2 | 3 | 1 | 3 | 2 3 |
| Thermit | 1 | 3 | 4 | 3 | 2 | 2 3 | 2 | 1 | 1 | 2 | 1 3 |
| Starlinger | 3 | 1 | 4 | 4 | 1 | 3 | 3 | 3 | 1 5 | 3 | 2 5 |
| LML | 2 75 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 7 |
| TISCO | 1 5 | 1 5 | 2 | 3 | | 2 5 | 3 | 1 | 1 | 3 | 1 7 |
| ICI | 2 5 | 2 | 2 | 3 | | 2 5 | 2 | 3 | 2 | 2 | 2 3 |
| GEC | 2 | 1 | 3 | 4 | 1 | 2 7 | 3 | 3 | 2 | 3 | 2 7 |
| Inject | 2 25 | 2 | 3 | 4 | 1 | 2 7 | 2 | 3 | 3 | 2 | 2 7 |
| Bee Chems | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 3 |
| Mod Bread | 2 | 2 | 2 | 3 | 3 | 2 7 | 2 | 3 | 2 | 1 | 2 |
| Vansal | 1 2 | 2 | 2 | 1 | 1 | 1 7 | 2 | 1 | 1 | 1 | 1 |
| TELCO | 2 75 | 2 | 3 | 3 | 2 | 2 7 | 2 5 | 3 | 2 | 3 | 2 7 |
| Ordnance | 1 25 | 1 | 3 | 2 | 4 | 3 | 2 | 1 | 1 | 2 | 1 7 |
| Networks | 2 25 | 2 | 2 | 4 | 1 | 2 3 | 3 | 3 | 3 | 1 | 2 3 |
| Hans Met | 1 5 | 2 | 3 | 1 | 1 | 1 7 | 2 | 3 | 1 | 2 | 2 |
| Polyplex | 1 | 2 | 3 | 3 | 1 | 2 3 | 3 | 3 | 1 5 | 2 | 2 2 |

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